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EVALUATION OF THE BOEING PAN AIR TECHNOLOGIES CODE (A502I) THROUGH PREDICTION OF SEPARATION FORCES ON THE GBU-24

by

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March, 1996

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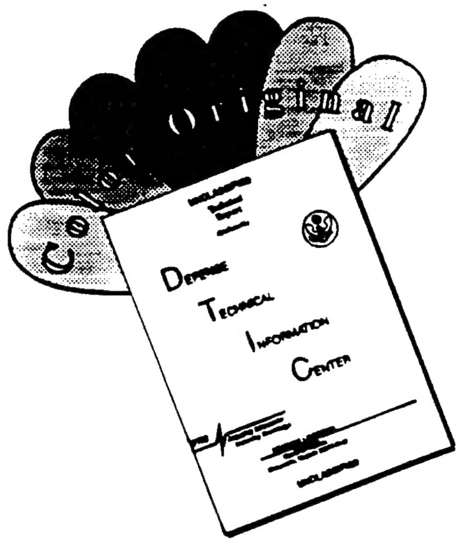

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The Boeing PAN AIR Technologies code (A502i) is investigated to explore its suitability for determination of separation forces on ordnance. To this end, A502i is first assessed by applying it to three problems for which other solutions and experimental data are available, i.e. steady flow past a rectangular, parabolic arc wing and a delta wing at both subsonic and supersonic conditions. Good agreement is found in all cases. A502i is then applied to the GBU-24's being in two configurations for a subsonic case and a supersonic case. Good agreement is found with data obtained from wind tunnel experiments for low angles of attack.

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I. INTRODUCTION

In the past, ballistic trajectory determination for manual or computer predicted ordnance delivery from an aircraft was determined through measurement of separation forces on the piece of ordnance via wind tunnel or captive carry measurements. The advent of panel method codes using linearized potential theory, such as A502i, or its full potential version TranAir, allow for a cheaper and safer method of predicting separation forces. Furthermore, A502i allows for any arbitrary configuration to be modelled within the limitations of the number of panels and networks allowed and excluding transonic flow.

The purpose of this work was to determine the separation forces on a GBU-24 carried by an F-14 on stations 3 or 6 or both. It was also the purpose of this work to provide an analysis of the code itself to see if it is a viable tool for the study of flow characteristics over arbitrary wing configurations for use in the Naval Postgraduate School's (NPS) Department of Aeronautics and Astronautics. The majority of the work was conducted on the NPS computer systems. The Department of Aeronautics and Astronautics Silicon Graphics Incorporated (SGI) workstations were utilized for most of the input files as well as the execution of the code. Due to the amount of disk space required, storage of the output files took place on the NPS Computer Center's Y-MP EL98 Cray computer. The bulk of the GBU-24 data was calculated using the SGI workstations at the Naval Air Warfare Center in Warminster.

The scope of this analysis was to understand the capabilities of the A502i code. The approach was to validate A502i against existing data and linear theory. The code was run for three different geometries under assorted Mach and AOA conditions. Comparisons were made for each of the geometries.

II. OVERVIEW OF THE A502i CODE

The A502i code is used to computationally analyze inviscid subsonic or supersonic flows about arbitrary configurations. The code differs from other panel methods in that it is a higher order panel method; that is, the singularity strengths are not constant on each panel. A502i solves the linearized potential flow boundary-value problem at subsonic and supersonic Mach numbers.

The aerodynamic solution provides surface flow properties (flow directions, pressures, Mach number), configuration forces and moments, sectional forces and moments, and pressures. Additionally, A502i calculates flow properties in the flow-field points and flow-field streamlines. Results are limited to subsonic and supersonic cases (transonic cases excluded) with attached flow. Results are not usually applicable to cases where viscous effects and separation are dominant.

A. THEORY

The basic equations describing the flow of a viscous, compressible, heat-conducting fluid are the Navier-Stokes equations. These are:

(a) The continuity equation,

$$\frac{\partial \rho}{\partial t} + \nabla \bullet (\rho \vec{V}) = \frac{\partial \rho}{\partial t} + \sum_{i=1}^{3} \frac{\partial (\rho V_i)}{\partial x_i} = 0 \tag{2.1}$$

where $\nabla = (\frac{\partial}{\partial x_1}, \frac{\partial}{\partial x_2}, \frac{\partial}{\partial x_3})$ is the gradient operator with respect to the location vector $\vec{x} = (x_1, x_2, x_3)$, and where the conventional index notation is used instead of $\vec{x}=(x,y,z)$. In addition, t is time, $\rho(\vec{x},t)$ is the density and $\vec{V}(\vec{x},t)$ is the velocity vector, with components $\vec{V} = (V_1, V_2, V_3)$.

(b) The conservation of momentum equation,

$$\frac{\partial}{\partial t}(\rho V_j)+\sum_{i=1}^{3}\frac{\partial}{\partial x_i}(\rho V_i V_j)=\frac{-\partial p}{\partial x_j}+\sum_{i=1}^{3}\frac{\partial}{\partial x_i}\tau_{ji}+\rho f_j \quad (j=1,2,3) \tag{2.2}$$

where τ_{ij} is the deviatoric portion of the stress tensor which vanishes for a frictionless fluid, $\vec{f}(\vec{x},t)$ is an external body force per unit mass exerted on the fluid, and $p(\vec{x},t)$ is the pressure.

(c) The conservation of energy equation

$$\begin{aligned}&\frac{\partial}{\partial t}(\rho e+\frac{1}{2}\rho|\vec{V}|^2+p)+\sum_{i=1}^{3}\frac{\partial}{\partial x_i}[(\rho e+\frac{1}{2}\rho|\vec{V}|^2+p)V_i]\\ &=\frac{\partial p}{\partial t}+\sum_{i,m}\frac{\partial}{\partial x_i}(\tau_{im}V_m+k\frac{\partial T}{\partial x_i})+\rho\sum_i f_i V_i\end{aligned} \tag{2.3}$$

where $e(\vec{x},t)$ is the internal energy of the fluid, k is the coefficient of heat conductivity for the fluid, and $T(\vec{x},t)$ is the temperature.

(d) The equation of state

$$f(\rho, p, T)=0 \tag{2.4}$$

where the function f depends on the type of fluid. The derivations of these equations can be found in Refs. 1,2 and 3.

The Navier-Stokes equations can be simplified by the neglect of viscosity, which is equivalent to setting the deviatoric stress tensor to zero. Combining the momentum and continuity equations yields

$$\rho\frac{dV_j}{dt}=-\frac{\partial p}{\partial x_j}+\rho f_j \quad j=1,2,3 \tag{2.5}$$

where the convective derivative operator is defined as

$$\frac{d}{dt}=\frac{\partial}{\partial t}+\sum_i V_i\frac{\partial}{\partial x_i}$$

Equation (2.5) is referred to as Euler's equation. The continuity and energy equations can

Equation (2.5) is referred to as Euler's equation. The continuity and energy equations can be reduced to

$$\rho \frac{d}{dt}\left(\frac{1}{2}|\vec{V}|^2\right) = -\vec{V} \bullet \nabla p + \rho \vec{V} \bullet \vec{f} \tag{2.6}$$

and the rate of increase of heat per unit mass is given by

$$q = \frac{1}{\rho} \nabla \bullet (k \nabla T) = \frac{d\rho}{dt} + p \frac{d}{dt}\left(\frac{1}{\rho}\right) \tag{2.7}$$

Equations 2.5, 2.6 and 2.7 can be reduced to a single equation when four further assumptions are made. First, assume isentropic flow, thus

$$q=0 \tag{2.8}$$

Second, assume irrotationality

$$\nabla x \vec{V} = 0 \tag{2.9}$$

which allows for the introduction of the potential function [Refs 2,3]

$$\nabla \Phi = \vec{V} \tag{2.10}$$

Third, assume the existence of a freestream potential Φ_∞, whose gradient is the uniform velocity $\vec{V}_\infty$ attained at points sufficiently distant from the disturbance being analyzed, and thus write

$$\phi = \Phi - \Phi_\infty \tag{2.11}$$

and

$$\vec{V} = (u, v, w) = \nabla \Phi = \nabla \Phi_\infty + \nabla \phi = \vec{V}_\infty + \nabla \phi \tag{2.12}$$

The quantities ϕ and $\vec{v}$ are called the perturbation potential and velocity [Ref 3]. Fourth, assume that

$$|\vec{v}|^2 \ll a_\infty \tag{2.13}$$

everywhere, where a_∞ is the freestream speed of sound.

Based on these four assumptions, the unsteady potential equation is obtained [Refs 1,3]:

$$
\begin{aligned}
&(1-M_\infty^2)\phi_{xx}+\phi_{yy}+\phi_{zz}-2M_\infty^2\phi_{xt}-M_\infty^2\phi_{tt} \\
&=M_\infty^2[\frac{1}{2}(\gamma-1)(2u+2\phi_t+|\vec{v}|^2)\nabla^2\phi \\
&+(2u-u^2)\phi_{xx}+v^2\phi_{yy}+2vw\phi_{yz}+w^2\phi_{zz} \\
&+2(1+u)(v\phi_{xy}+w\phi_{xz})+2(uu_t+vv_t+ww_t)]
\end{aligned}
\tag{2.14}
$$

Assuming the flow conditions do not change with time yields the steady non-linear potential equation.

$$
\begin{aligned}
&(1-M_\infty^2)\phi_{xx}+\phi_{yy}+\phi_{zz} \\
&=M_\infty^2[\frac{1}{2}(\gamma-1)(2u+|\vec{v}|^2)\nabla^2\phi \\
&+(2u+u^2)\phi_{xx}+v^2\phi_{yy}+2vw\phi_{yz}+w^2\phi_{zz} \\
&+2(1+u)(v\phi_{xy}+w\phi_{xz})]
\end{aligned}
\tag{2.15}
$$

When M_∞=0, equation (2.15) reduces to Laplace's equation,

$$\nabla^2\phi=0 \tag{2.16}$$

For the case of $M_\infty \neq 0$, the following is supposed,

$$M_\infty^2|\vec{v}| \ll 1-M_\infty^2 \tag{2.17}$$

$$M_\infty^2|\vec{v}| \ll 1 \tag{2.18}$$

which are small perturbation assumptions [Refs. 1,2]. With these assumptions the steady non-linear potential equation reduces to the Prandtl-Glauert equation [Ref 1]:

$$(1-M_\infty^2)\phi_{xx}+\phi_{yy}+\phi_{zz}=0 \tag{2.19}$$

Through a coordinate transformation [Refs. 1,2,3], the Prandtl-Glauert equation can be re-written as:

$$s\phi_{\bar{x}\bar{x}} + \phi_{\bar{y}\bar{y}} + \phi_{\bar{z}\bar{z}} = 0 \tag{2.20}$$

where when s=1, it is the subsonic case and Laplace's equation applies and when s=-1, it is the supersonic case and the wave equation applies. Applying Green's third identity [Ref. 1] yields the following integral equation,

$$\phi(P) = -\frac{1}{4\pi}\int\int_{s}\left[\frac{\sigma}{R} - \mu\hat{n} \bullet \nabla\frac{1}{R}\right]dS \tag{2.21}$$

where σ represents the source strength and μ represents the doublet strength. When supplemented with boundary conditions, it is equation (2.21) that A502i solves.

A502i solves equation (2.21) through a discretization process. The general idea of the process falls into two parts. The first is developing finite dimensional approximate representation formulas for the singularity functions, which creates a system of equations with unknown coefficients, λ_i. The second part involves solving the set of equations for all λ_i. This allows for completely determining the source and doublet functions. Then, by virtue of equation (2.21), the potential function $\phi(P)$ is determined for all points P, solving the problem.

The features of A502i which distinguish it from predecessors are three-fold. The first is a feature known as "continuous geometry", the second is linear source and quadratic doublet variation, the third is continuity of doublet strength.

Most panel methods approximate the configuration geometry with panels whose planform is a quadrilateral. Thus, if the panels themselves are planar, only a small class of configurations (such as cylinders and flat wings) can be described without gaps being left between panels. These gaps are generally small, except for highly twisted surfaces. The

gaps cause little numerical error in subsonic flow, but in supersonic flow, the cumulative effect of the gaps is serious [Ref. 1]. The problem is not associated with leakage of flow through the gaps, but with the doublet strength jumping abruptly from a non-zero value to zero at a panel edge which does not exactly meet the adjacent edge. In A502i, gaps are closed by means of panels which are comprised of several planar regions.

The feature of linear source and quadratic doublet variation is what makes A502i a higher order panel method. The basis function corresponding to a source parameter is locally linear, while the basis function corresponding to a doublet parameter is locally quadratic. This is what allows for A502i to find supersonic solutions. Numerical solution of the wave equation is far more sensitive to the numerical idiosyncracies of a panel method than is the solution of Laplace's equation for subsonic flow. Experimental evidence [Ref. 1] indicates that exact surface analysis is not feasible in supersonic flow without doublet continuity, thus the potential for numerical error is greatly reduced by requiring the doublet singularity strength to be continuous across panels.

B. GENERAL A502i USAGE

The use of the A502i code consists of generating an input file, which can be arbitrarily named, and which contains the information defining the geometry of the configuration, flow field points of interest, the flow conditions and wakes. The process of building a geometry is difficult in that A502i is particular about its input format. Simple configurations, such as a rectangular, planform wing can be modelled manually, but more complex structures require a pre-processing program, such as MACGS, where a geometry can be graphically built. MACGS will output a data file in a format that, with minor modifications, via another pre-processing program that can move the data from three columns to six columns, will be readily usable by A502i. Currently, the school does not have a copy of MACGS, but it can be acquired through McDonnell-Douglas. To complete

this thesis, MACGS was used on the SGI workstations at NAWC Warminster. Wakes also must be constructed in the same manner as the structure to be analyzed. More detailed instructions on the specifics of wakes and surface geometries can be found in Ref. [4]. Appendix A is a portion of an output file, but lines 1 thru 1120 are an exact duplicate of the input file.

1. Running A502i with an Existing Executable

Assuming an A502i executable file (e.g., A502) has already been placed in a user executable directory (e.g., /usr/local/bin), the only other necessary items needed to produce a set of A502i output files is the input file and a large amount of storage space. Anything modelled with more than one thousand panels total will use more than one hundred mb of disk space. If the maximum number of panels (20,000) is used, the disk space required will be on the order of 2 gb.

To run A502i, enter after the UNIX prompt:

A502 *<input file > output file*

Prior to running the code, it is highly recommended that a Cray account be opened and linked to the department's SGI workstations. This is done by assigning the same user i.d. number to the Cray account as is assigned to the account with the department. User i.d. numbers can be changed by the computer center at the user's request. This is required due to the limited disk space available to individual accounts in the department. Once an account is opened, log on to a department workstation, change directories to an existing Cray directory, for example (after the UNIX prompt):

cd /jedi/d1/maletour

Transfer the input file to the Cray directory and execute the code. The screen will display what portion of the code it is performing and how long it took to perform each portion in CPU time. The code outputs numerous files in addition to the arbitrarily named output file.

The two output files of interest, in the vast majority of cases, are the arbitrarily named output file and the ft13 file. In order to run another solution all output files must be deleted or renamed prior to re-executing the code. Relevant results should not be kept on the Cray account as files on disks d1, d2 and u1 are considered temporary storage and subject to erasure after a period of time.

2. Creating an A502i Input File

The input file, which can be arbitrarily named, consists of two portions, the largest being the geometry data. Appendix A is a complete recreation of the input file for the GBU-24 with canards. The file begins with line 1, $TITLE, and ends with line 1120, $END. The line numbers are for reference only and are not part of the actual input file. The first portion consists of creating the initial conditions, i.e., the free-stream Mach number and angle of attack, the type of analysis to be performed, i.e., solution or datacheck, what types of output that are to be included in the arbitrarily named output file, and reference points to be used in calculating forces and moments. The geometry data consists of the points that bound each panel, that in turn belong to a specific group of panels that make up a network. The overall structure being modelled consists of a series of networks. A502i can run up to 150 networks and or 20,000 panels with a limit of 8,000 panels per network. Referencing Appendix A, line 28 represents the first network of the model, a canard. Line 29 represents the number of networks that will be classified under this $POINTS statement. Line 30 indicates what kind of surface the network will be, a three-dimensional surface with flow properties to be calculated, a wake and a base are several examples. Line 31 is the number of y points and the number of x points respectively that make up the grid of that network. Line 32 is where the panel points start. Reference 4 contains detailed instructions on the options and meaning of each of the non-geometry inputs, including some capabilities not shown in Appendix A.

Two types of solutions can be run, a datacheck and a full solution. Reference 4 explains how to enter either one into the input file. The datacheck only analyzes the geometry. This can be accomplished in a matter of seconds for a simple geometry as it is only running the first several portions of the code. The full solution can take a couple of hours for a geometry of the size of 4,000 panels. The datacheck should be run once the geometry has been modelled. It will check for any panel edges that do not abut properly, and when column 4 of line 20 in Appendix A is a 1, the datacheck will list the unit normal vectors, which must be facing outward. The datacheck will also see if the wakes are attached properly. A502i is capable of giving warnings both on-screen and in the arbitrarily named output file when an edge or a wake is not modelled properly, but it only lists the unit normal vectors. The directions of the vectors must be manually checked by the user. The full solution performs the datacheck first, so the data is repeated in the arbitrarily named output file. Appendix B is a portion of the output file that contains the summary of facing surfaces. Each panel edge is looked at to see what it abuts against. Sections such as wingtips, leading edges of a flat plate or any surface that does not need a wake attached, but is unabutted to any other panel on that edge will draw probable error messages or warnings from the code. The user must ensure that the edge is not supposed to abut against anything or need a wake attached. If that is the case, the warnings may be ignored. Appendix D is the first page of the portion of the output file that lists the unit normal vectors. The three columns under zc are the x-y-z coordinates of the given panel's center. The three columns under znc are the x-y-z coordinates of the unit normal vector. In most cases, when the y coordinates are of the same sign, then the unit normal vector is pointing outward.

C. GEOMETRY MODELLING

Five geometries needed to be modelled, each of increasing complexity. Modelling proved to be the most difficult task, in that A502i is a FORTRAN code and is very format sensitive, but the sheer number of points that need to be generated can take a lot of time and the order those points are listed in the input file is what determines whether or not the shape is correctly modelled. Of the five geometries modelled, none were done completely manually. A spreadsheet was used for generating the parabolic arc airfoil and the deltawing since those structures can be constructed out of one network, excluding wingtips and wakes, and the surface can be defined by a mathematical function. The bombs and the F-14 required the use of MACGS to be properly modelled. MACGS is indifferent as to the order that geometries are built, and often doesn't require many coordinate inputs if building a model on top of an existing IGS file. The output file from MACGS is automatically formatted and the points placed in the appropriate order for A502i to understand. Although, the order may be reversed where the unit outward normal vector is concerned. MACGS has the ability to output files in several different panel method code input formats, including PMARC. Reference 4 gives detailed instructions on how to properly order points to build a group of networks that will model a geometry. A502i uses a right-handed coordinate system that is similar to an aircraft body axes. When put in terms of a wing, the x axis is positive from leading edge to trailing edge. The z axis is positive up and the y axis is positive out the right wing

1. The Parabolic Arc Airfoil

The parabolic arc airfoil is the simplest of all the geometries. The airfoil has a chord of five and a span of ten. The maximum thickness is .15. The model consists of approximately 600 panels, including the wake and wingtips. A spreadsheet was used to develop the geometry portion of the input file. Line 32 of Appendix A demonstrates the

format that the spreadsheet used. Rows consist of two points, with coordinates x1, y1, z1, x2, y2, z2 using a format of 6F10.0. The chord was divided into 25 points (x coordinate) from trailing edge to leading edge and then another 25 points from leading edge to trailing edge (bottom half). The span was divided into 12 points (y coordinate) from left to right. Due to the symmetry of a rectangular planform, the y coordinate was constant along the 50 x coordinates that constituted a chordwise cross-section. To attain a maximum thickness of .15 the formula,

$$z = .3 * \left(\frac{x}{c} - \frac{x}{c^2}\right) \tag{2.22}$$

was utilized to generate the values of the z coordinates. The wingtips simply connect the x coordinate on the top side with it's symmetrical counterpart on the bottom side. Due to a trailing edge composed of a straight line, the wake is modelled by a single panel that spans the trailing edge and has a length aft of 100. Figure 2.1 shows the panel distribution across the top surface of the parabolic arc airfoil, where the thickness is represented by the color scheme. A panel and a point are numbered to show how they were entered into the input file.

2. The Deltawing

The deltawing represented a step up in complexity over the parabolic arc airfoil. The chordwise cross-section is parabolic, while the spanwise cross-section is linear. The procedure for building the geometry on a spreadsheet was the same as that for the parabolic arc airfoil, only the chord length is not constant along the span. For simplicity in design, the number of panels per column of panels is constant on the deltawing, as on the parabolic arc airfoil. This means an increasing panel density in the direction of the wing tip. The wake is modelled the same as the airfoil. The right wingtip ended in a point, so no extra panelling was needed to close any gaps. The symmetry of the deltawing allowed for

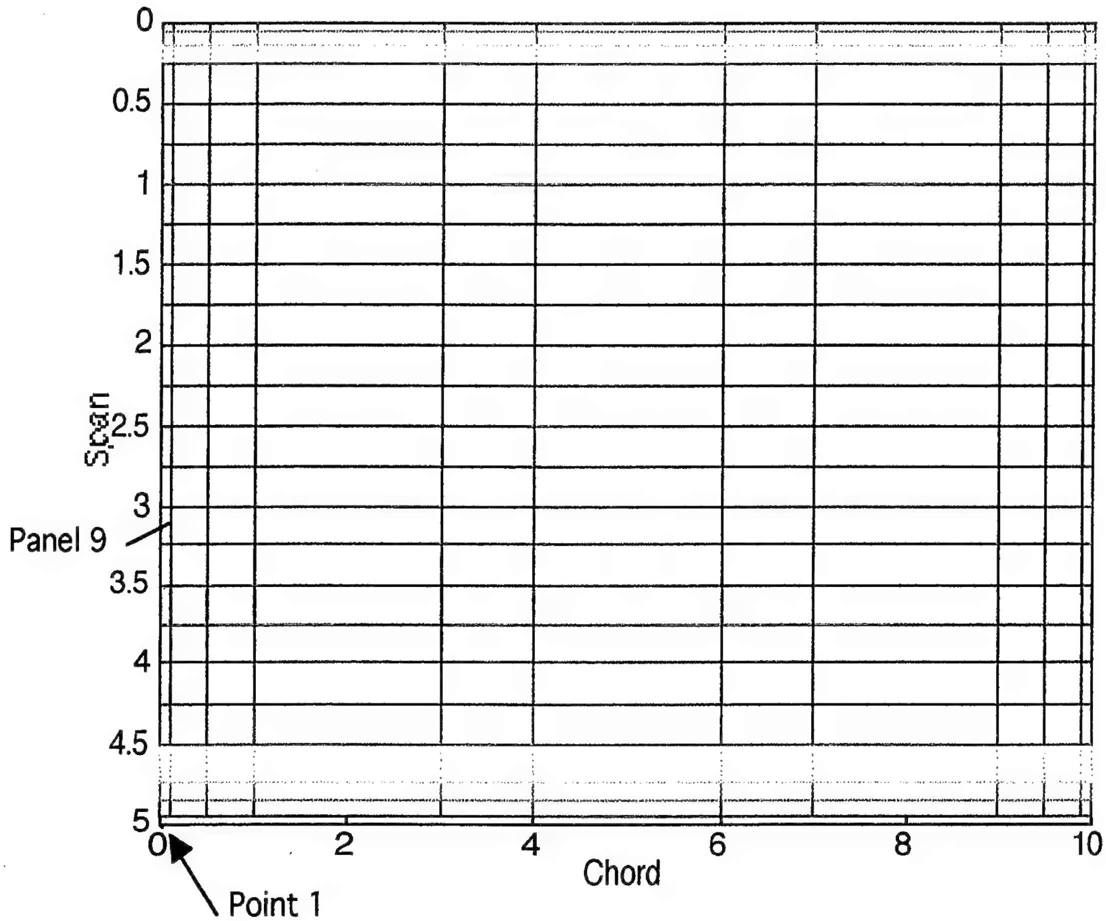

Figure 2.1 Parabolic Arc Panel Distribution

further simplification and reduction of the code's run time by only modelling from the centerline to the right tip. A502i allows the user to stipulate whether there is symmetry in the x-z plane and or the x-y plane (see line 5 and 6 of Appendix A). This means that the gap between the top and bottom panels at the center line does not need to be bridged as in the parabolic arc airfoil (symmetry could have also been used in the airfoil's case). The chord of the deltawing has a length of 90 and the semi-span has a length of 15. The maximum thickness occurs midway along the centerline and is .05. The model consists of 880 panels. Figure 2.2 shows the panel distribution along the top surface of the deltawing.

Thickness is represented by the color scheme.

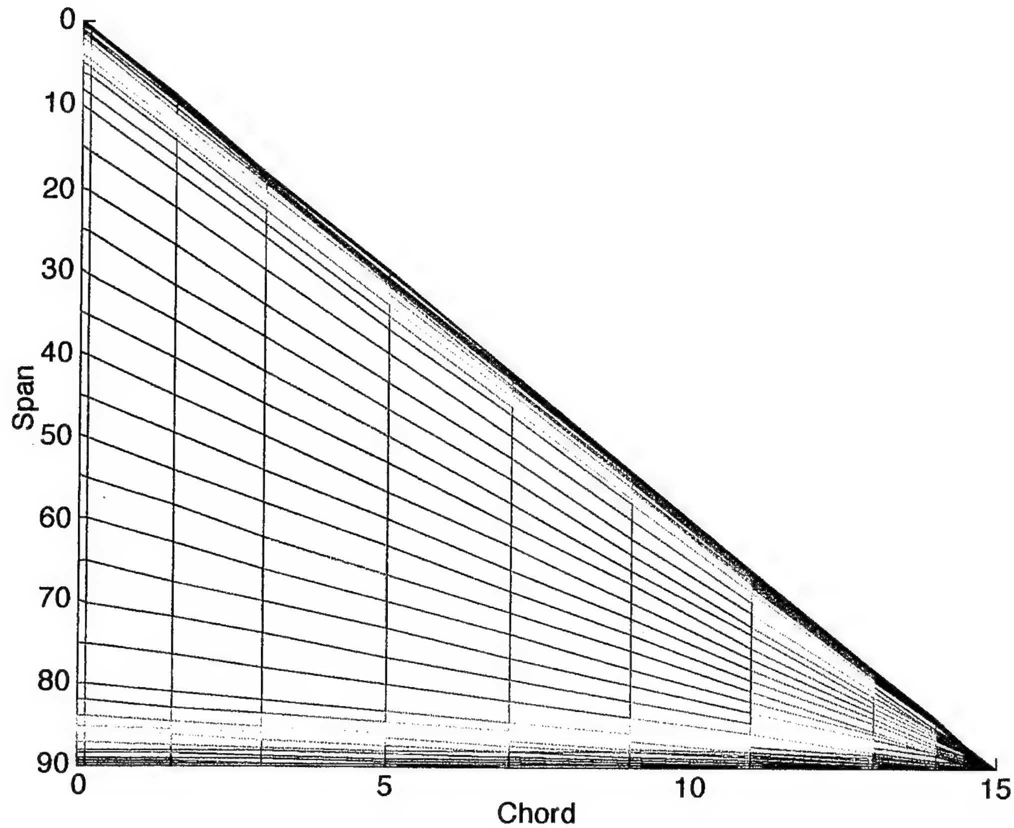

Figure 2.2 Panel Distribution of Deltawing

3. GBU-24

Wind tunnel experiments were run on the GBU-24 without canards attached, so it was deemed relevant to build a model with and without canards as a comparison of the code's performance. The model of the GBU-24 was too complex to build with a spreadsheet, so MACGS was used. The bomb was modelled at NAWC Warminster by superimposing a group of networks on top of an IGS file being displayed by MACGS. The complete configuration consists of approximately 1300 panels. Figures 2.3 and 2.4 are displays of the GBU-24 with canards, with Figure 2.4 including the wakes. Figure 2.5

is included to show how the GBU-24 model was assembled. Each different color represents a network.

Several features of the geometry are relevant to point out. Two of them are modifications made to the geometry that differ from the actual dimensions of the bomb. Dr. Alex Cenko of NAWC Warminster has extensive experience with modelling stores in A502i. The modifications were made on his knowledge of how to get the most accurate results from the code when modelling stores. The first is to model the fins and canards as flat plates, i.e., no thickness, which A502i allows you to do through a single numerical change in the input code for each network that represents a flat plate (see line 30 of Appendix A). The fins and canards are extremely thin when compared to the rest of the bomb, and to add a third dimension to the geometry complicates the construction of the fin or canard for several reasons. The leading and trailing edges must be sharp and the surface the fin or canard attaches to would have to be modified to abut properly with two edges instead of one. Experience has shown that the simpler version yields accurate predictions. A502i is an inviscid code, so it cannot take into account separation effects on its own. The GBU-24 does not have a flat base. In reality, it is more bullet nosed in shape. However, at the speeds with which the bomb is being analyzed, separation does occur near the trailing edge of the bomb. Experience has shown that truncating the end into a flat base and designating it a separated flow region through an appropriate input (see line 702, column 1, Appendix A) yields better results than attempting to model the bomb to exact physical dimensions. The last feature to point out are the wakes, as seen in Figure 2.4. A502i has a limitation in that the wakes must be modelled by the user, and they have the same abutment requirements as physical surfaces. Regardless of angle of attack, the wakes remain stationary with respect to the body to which they are attached. At higher angles of attack, the wakes are no longer close to paralleling the free-stream velocity. Remodelling the wakes is nearly an impossible task. The fin and base wakes would not be too difficult

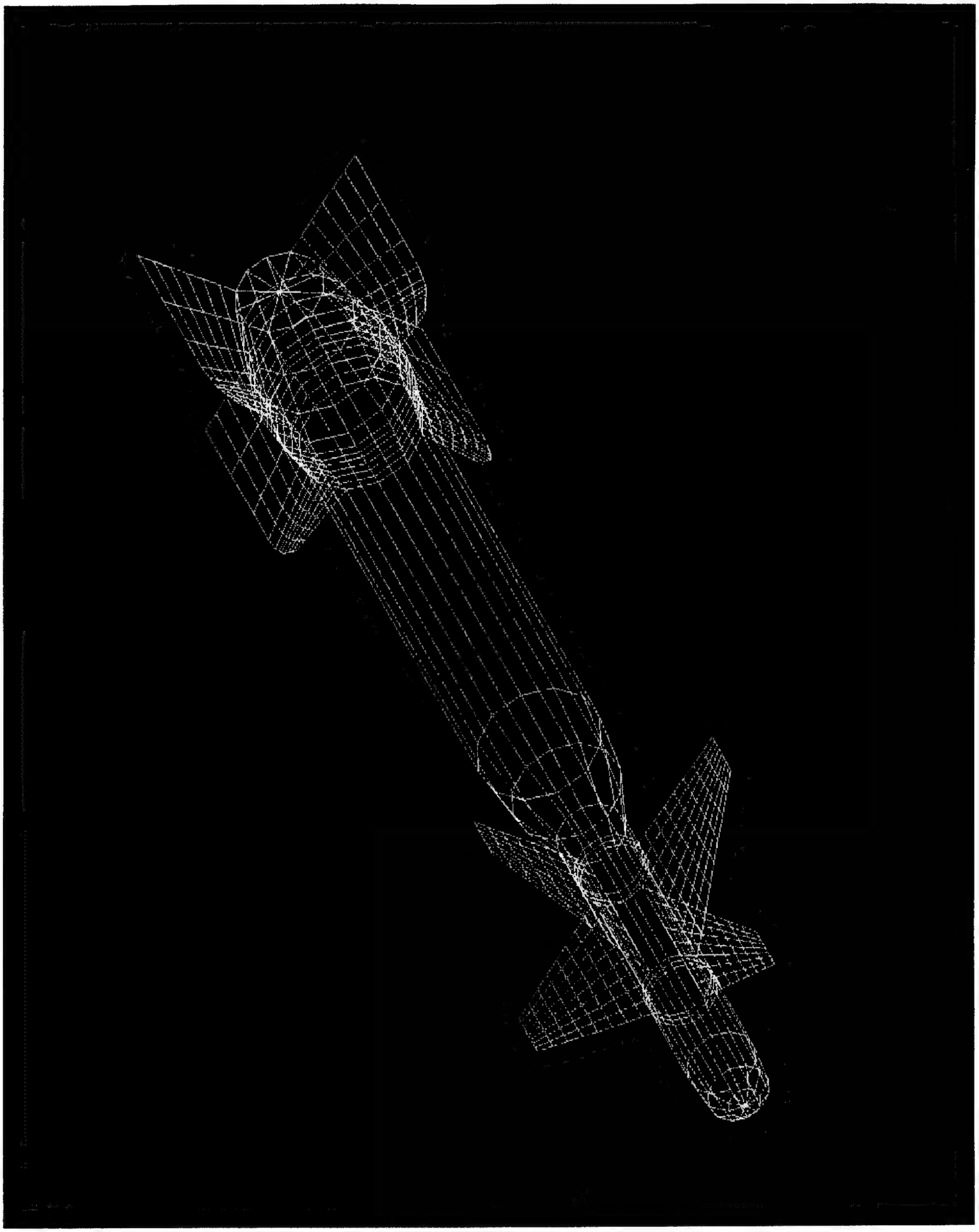

Figure 2.3 GBU-24 Geometry (Wakes not Shown)

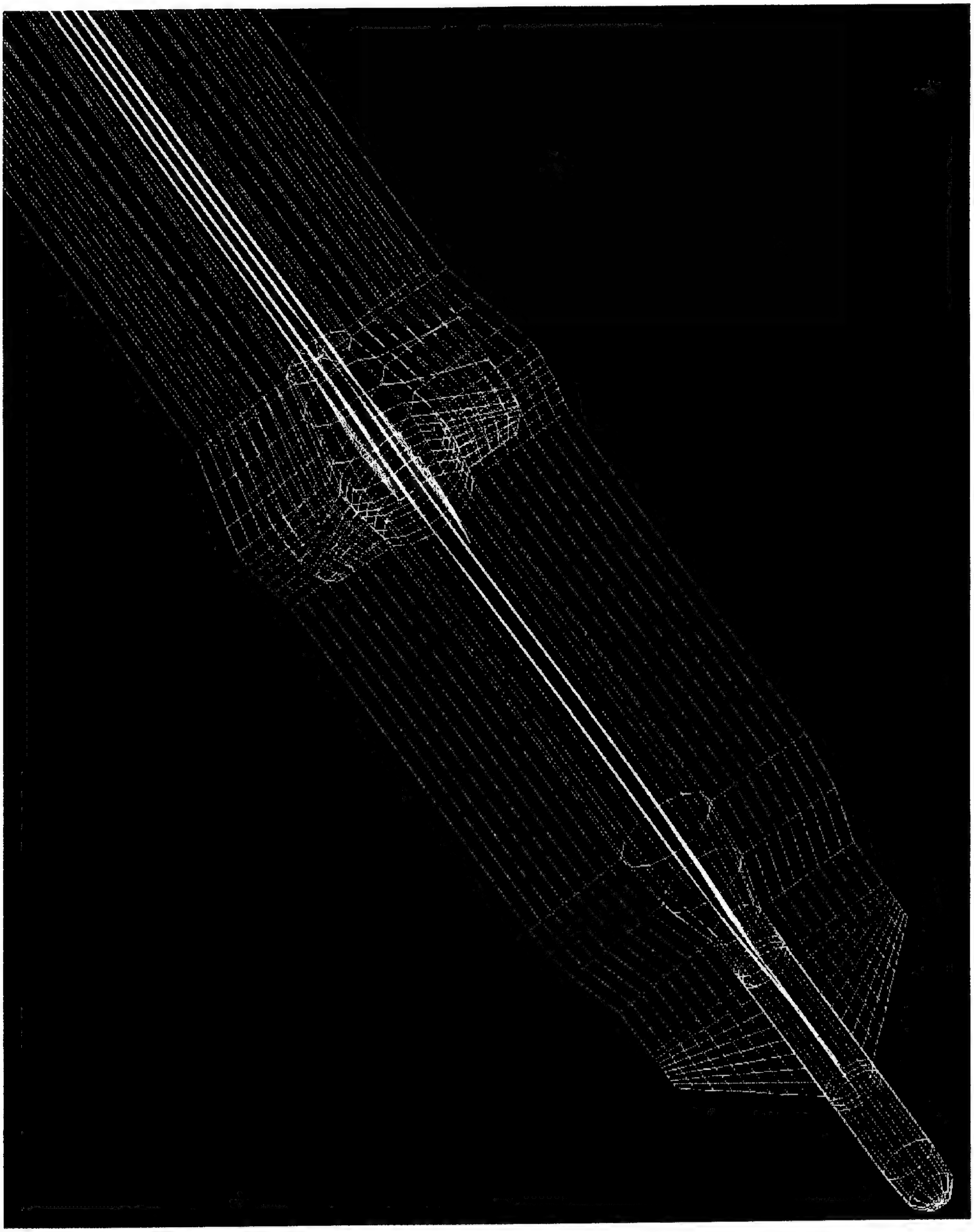

Figure 2.4 GBU-24 Geometry (Wakes Shown)

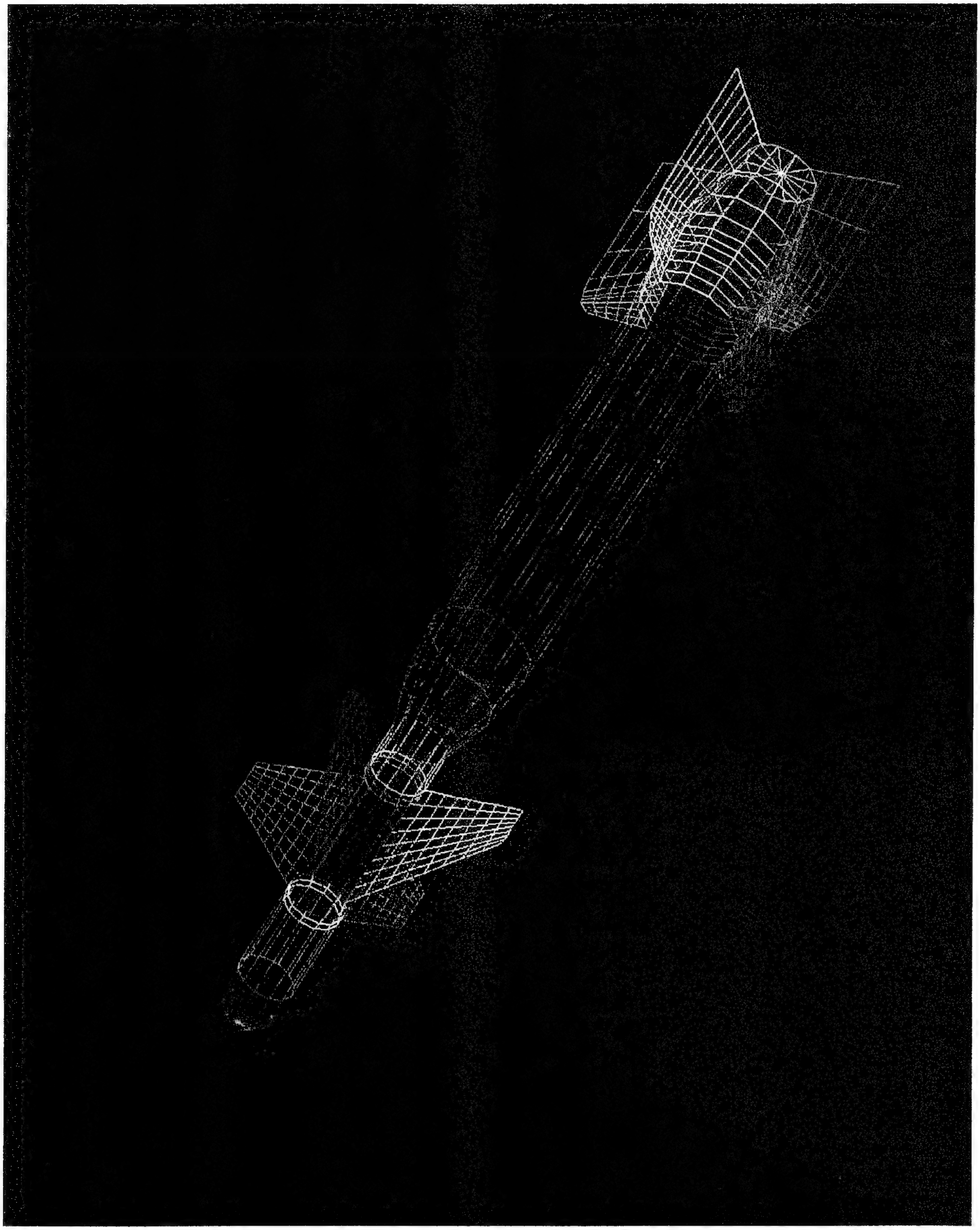

Figure 2.5 GBU-24 Geometry (Network Modelling)

because they do not abut against any physical surfaces except for the surfaces they are trailing from. The canard wakes must abut properly against the bomb's body all the way to the base. Modification of those wakes would entail modification of the entire body, or in a possible simplification, letting the wakes remain attached along the body until the base of the bomb and then shifting them relative to the free-stream.

4. The F-14

The F-14 geometry was modelled in the same fashion as the GBU-24. The geometry consists of approximately 1500 panels. While that may seem fairly coarse for such a complex structure, experience shows that it is all that is required to get accurate predictions. The primary area of interest is the underside of the fuselage forward and between the two nacelles. Higher panel density on the top half is not required. Figures 2.6 and 2.7 display the F-14 geometry without and with wakes shown. Several omissions are made to the model as having a trivial effect on the analysis or no effect at all. Phoenix rails and bomb racks are not modelled along with the chin pod because they are deemed insignificant to achieve reasonably accurate predictions over small angles of attack. External tanks were not considered, but could be modelled much in the same way as the bomb and inserted into the input file to see what effects the drop tanks have on separation forces. The vertical tails and horizontal stabilizers were deemed irrelevant to the prediction of the separation forces and were left out. This reduces the number of panels and networks, which also reduces the amount of time it takes to run a solution.

5. Combination Geometries

The F-14 and GBU-24 were modelled separately, but were combined together as shown in Figure 2.8. The first step to accomplish this was using the FORTRAN code NAVSEP which, among many of its functions will translate coordinates to relocate items in the flow-field. Once accomplished, the GBU-24 file was pasted into the F-14 input file.

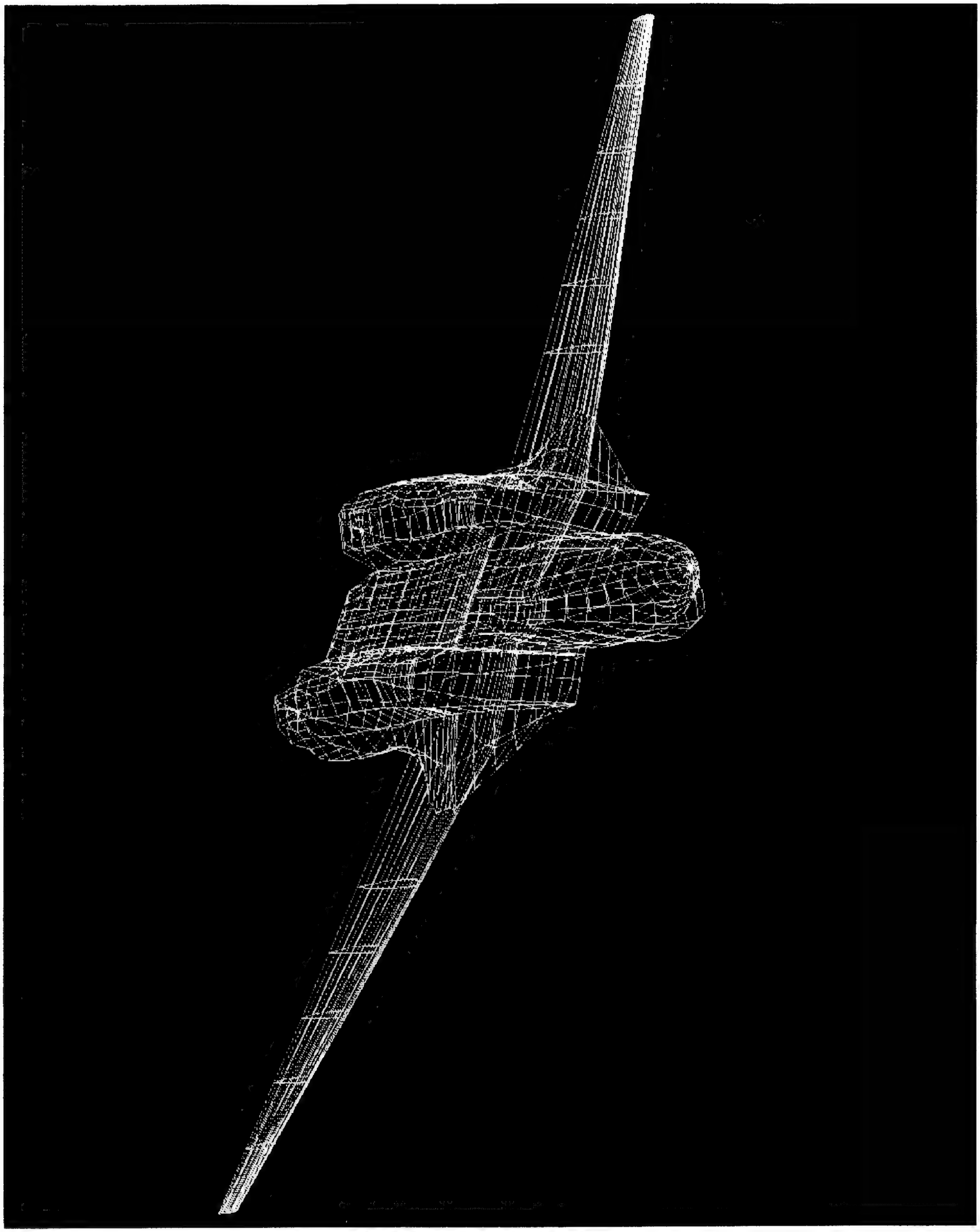

Figure 2.6 F-14 Geometry (Wakes not Shown)

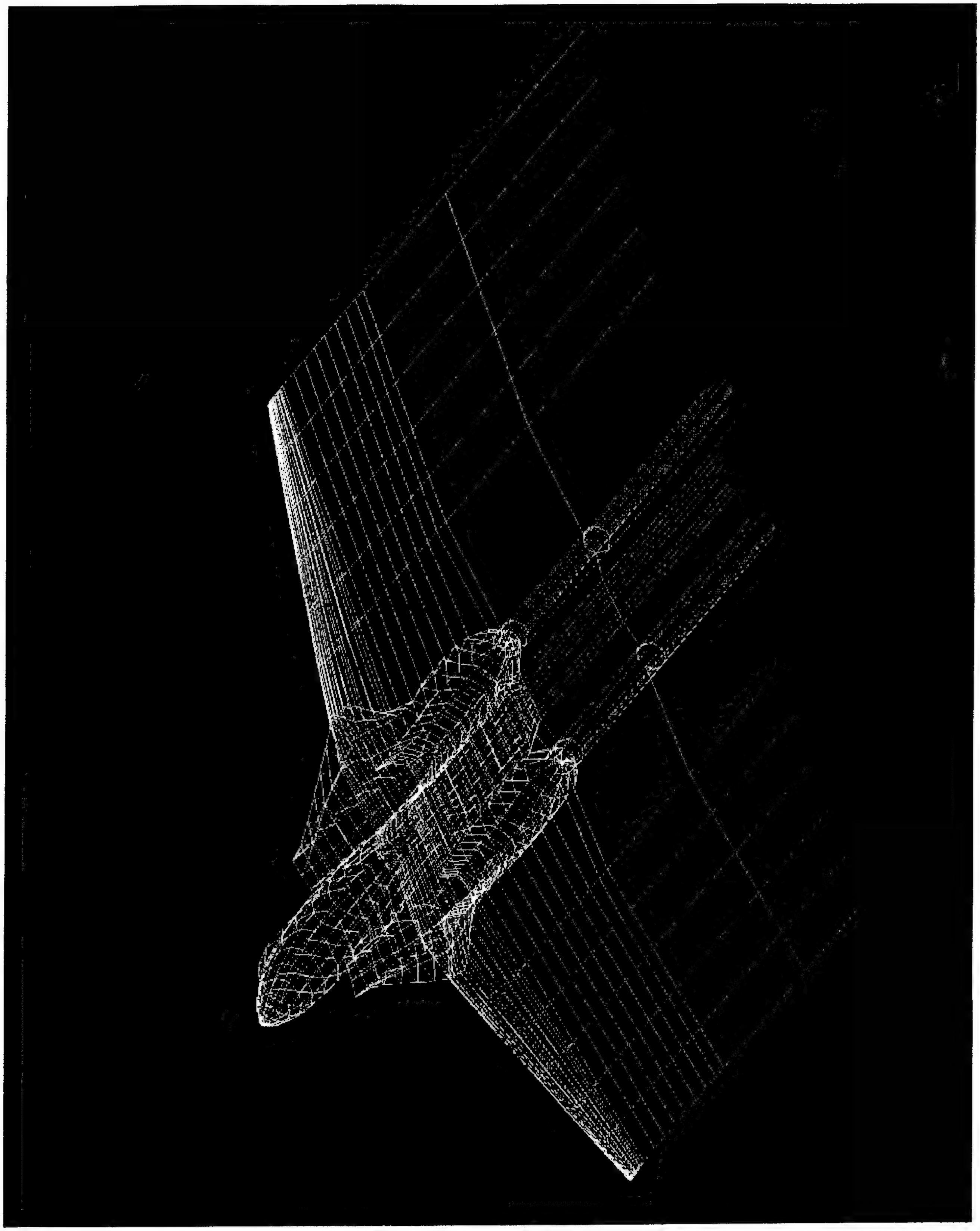

Figure 2.7 F-14 Geometry (Wakes Shown)

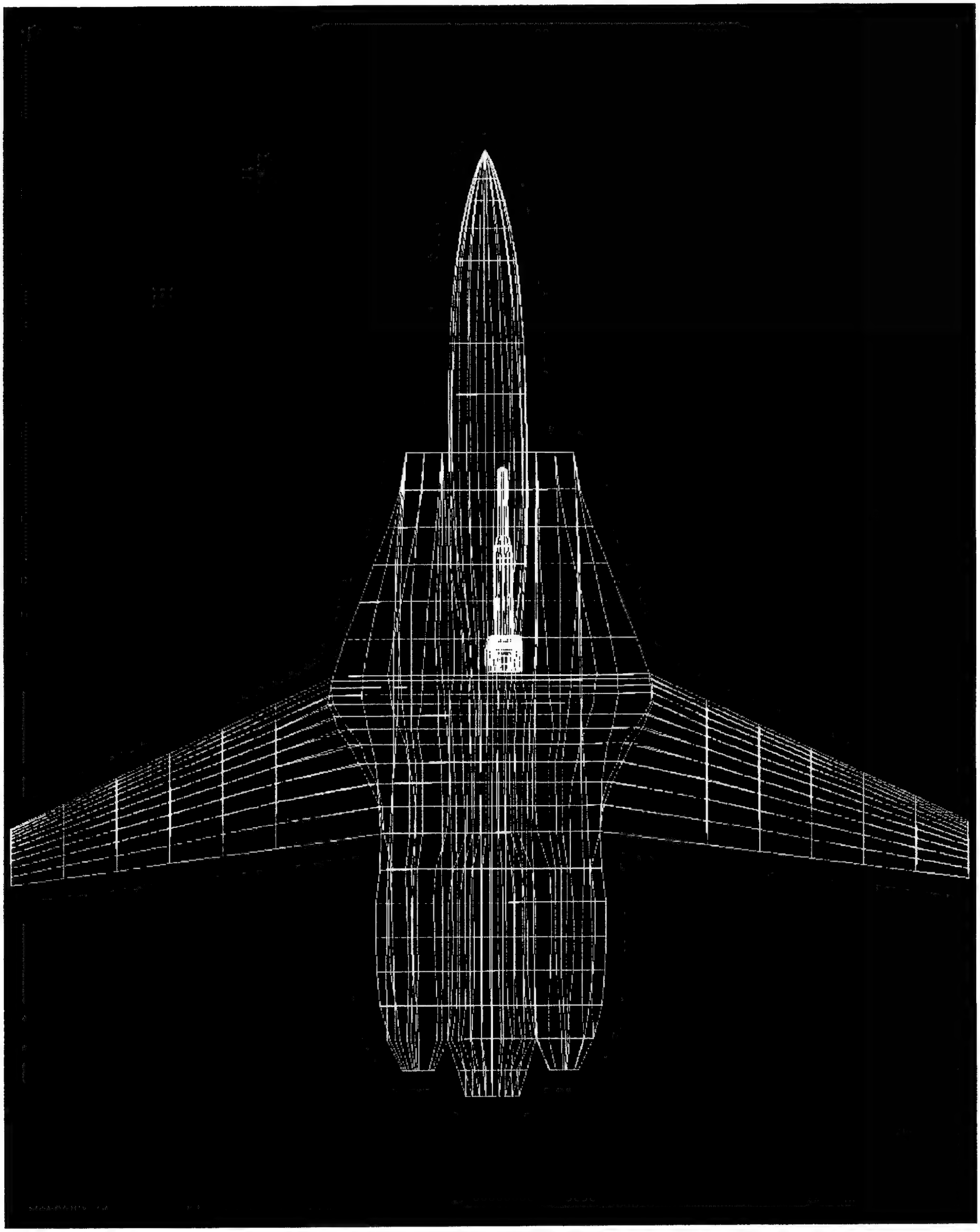

Figure 2.8 F-14 and GBU-24 on Station 3 Combined Geometries

D. GRAPHICS VISUALIZATION

One of the pre/post-processing codes that came with A502i is called RAID. Currently an executable exists in the department's computer system that can be accessed through typing after the UNIX prompt,

raid

Raid is a basic graphics program that can read A502i and TRANAIR input files and display geometries and flow properties from solutions. After accessing raid, it will ask what type of input file it is being asked to visualize. It can handle five other modes of input besides A502i/TRANAIR [Ref. 10]. It will then ask for the name of the input file. A prompt will follow asking about object definition matrices which needs to be answered by,

EACH

The next prompt will ask if the panels are going to be shaded by a Cp value. Cp is used generically in that Cp can be displayed or Mach or any of the relevant 49 surface flow properties [Ref. 4]. This is only used after a solution has been run, data has been extracted and a colorscale for contour plots has been determined. If only the geometry is to be displayed, then hit carriage return for all the next questions until a pink window appears with a menu in the lower left corner of the window. An anomaly of the program is that if you want to display the wakes, then wake display must be deselected. To view the geometry select view on the menu. All selections with the mouse in RAID are made with the center mouse button. A new window appears with a menu bar at the bottom and left and the geometry in the center. From there, rotation, translation, scaling, axes, reflections and other manipulation of the geometry is possible. Figures 2.3 through 2.8 are examples of geometries displayed on RAID.

When presentation of solutions (i.e., Cp or Mach contours) are desired, the use of another post-processing program is required to generate a colormap file. The program is

called crebar. An executable currently exists on the department's system. Type in,

crebar

after the UNIX prompt. The program will ask straightforward questions. Number values associated with colors available can be found in Ref. 10. The color file can be saved under any name, but must lie in the same directory as the input and solution files. The first line of the color file will list four numbers. The first number is the number of colors assigned to the colormap (248 maximum). Occasionally, the color bar displayed in RAID when using a colormap will disappear when certain menu items are selected. To prevent this, change the last three numbers to read 6, 1, -1. Plotting outputs from RAID requires saving the file in a format, such as RGB, that a printer will recognize. It is possible to change the text color and background color, the default is black, to avoid excessive use of black ink in hard copies.

III. DATA EXTRACTION

When a solution has run to completion, there are two files of interest, the arbitrarily named output file and the ft13 file. The arbitrarily named output file contains results for everything that A502i solves for. The ft13 file contains only the 49 surface flow properties on each panel. Appendix D is the solution portion of an arbitrarily named output file for the first network.

For purposes of displaying flow properties on RAID, it is necessary to utilize the ft13 file. A post-processing code called RAIDCONV is used to extract the specific information. To access RAIDCONV, type

raidconv

after the UNIX prompt. An executable currently exists in the department's system. The ft13 file must be in the same directory as RAIDCONV is accessed in. RAIDCONV will prompt the user for which kind of panel method is being used (A502i is one of three choices). The next prompt will ask for the name of the ft13 file. The last prompt will ask for the flow property that is to be extracted. A file called ft13.cp will be created. It can be renamed for purposes of multiple flow properties extraction. Abbreviations for the 49 flow properties can be found at the bottom of page 1 of Appendix D. The two primary flow properties are

LMACHU for local Mach number

CP2ND for second order pressure coefficient

CP2ND is the default setting for RAIDCONV. Once the ft13.cp file is created, RAID can be used as previously discussed to display the flow properties. An anomaly of RAIDCONV is that it does not recognize kt=20 type wakes, used where wakes from a wing abut against a body [Ref. 4]. To assist in extracting all the data, the kt=20 wakes

should be placed at the end of the input file. In general, it is good practice to place all wakes at the end of the input file when using A502i.

The arbitrarily named output file duplicates the data found in the ft13 file and includes moments and forces. A502i will sum up the moments and forces on each network and for all networks so far [App. D]. The moments are computed based on the coordinates entered into the input file [Ref. 4 and App. A].

IV. RESULTS OF A502i COMPUTATIONS

A. PARABOLIC ARC AIRFOIL DISCUSSION

This simple geometry was analyzed primarily to evaluate A502i's capabilities by a comparison to known linear theory. To this end, the geometry discussed in section II-C and shown in Figure 2.1 was run by A502i at a Mach of 0.3 and a Mach of 1.5 at an angle of attack of zero. Two of the 49 flow properties that A502i computes [Ref. 4] for each panel are linear Cp and second order Cp, given by

$$\mathrm{CPLIN} = -2u_c \tag{4.1}$$

$$\mathrm{CP2ND} = -2u_c-[(1-M_\infty^2)u_c^2+v_c^2+w_c^2] \tag{4.2}$$

Where u_c, v_c and w_c are the compressible components of the perturbation velocity. Figure 4.1 plots the linear theory, A502i linear and second order results for the subsonic case, while Figure 4.2 represents the supersonic solution.

Linear theory for parabolic arc airfoils is outlined in Refs. 2 and 3. The equation representing the subsonic case is given by:

$$Cp(x) = \frac{-8 * \tau_{max}}{\pi * \mathrm{chord} * \sqrt{1 - M_\infty^2}} * (1 - (.5 - x) * \ln\left|\frac{1-x}{x}\right|) \quad \text{where } 0 < x < 1 \tag{4.3}$$

Equation 4.3 includes a Prandtl-Glauert compressibility correction. The equation representing the supersonic case is given by:

$$\begin{aligned} Cp(x) &= \frac{2\theta}{\sqrt{M_\infty^2 - 1}} \quad \text{where } 0 < x < \mathrm{chord} \\ \text{and } \theta &= \tau_{max} * \left(\frac{1}{\mathrm{chord}} - \frac{2x}{\mathrm{chord}^2}\right) \end{aligned} \tag{4.4}$$

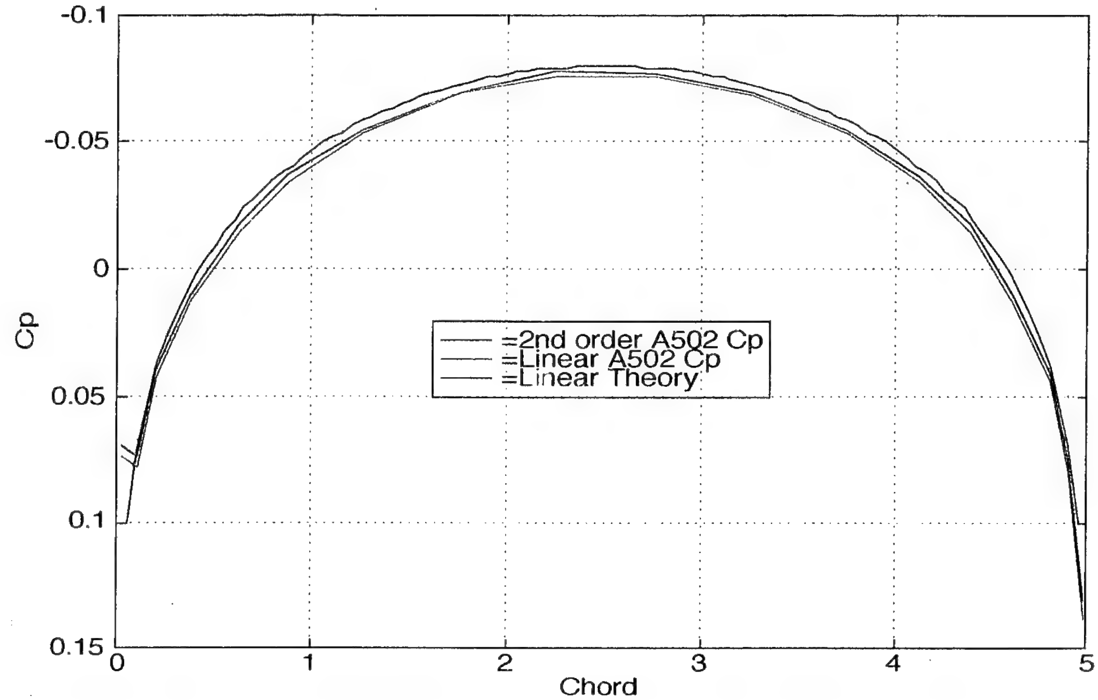

Figure 4.1 Cp Comparison of a Parabolic Arc Airfoil at Mach = 0.3.

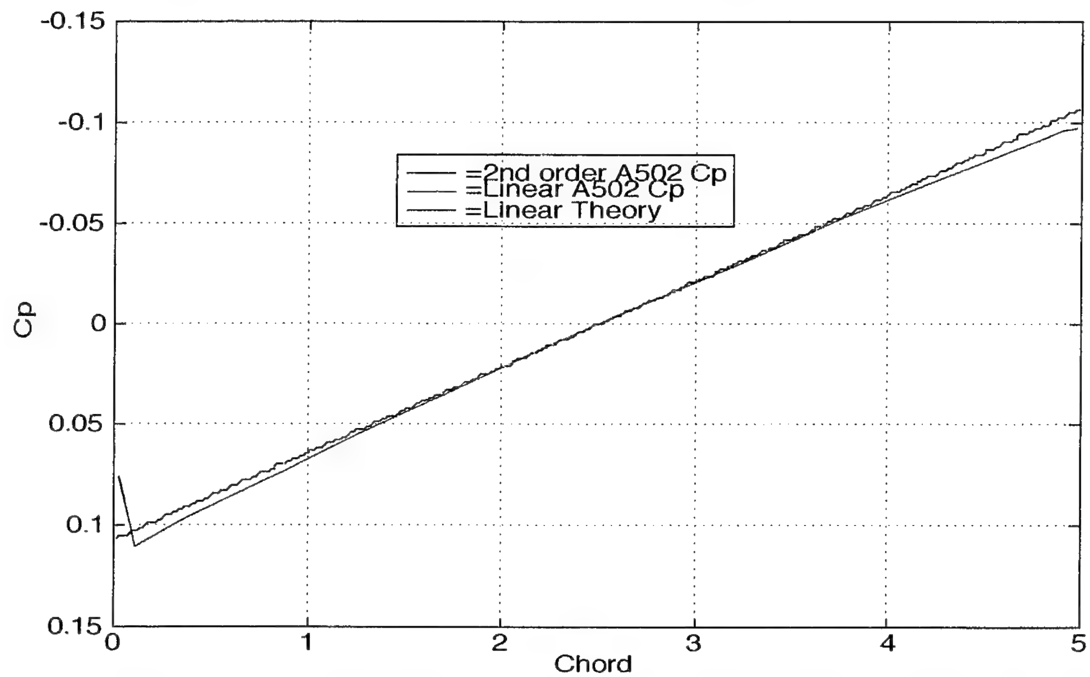

Figure 4.2 Cp Comparison of a Parabolic Arc Airfoil at Mach = 1.5.

Figure 4.1 shows very good agreement with the linear theory curve. There is a small but noticeable difference between A502i's linear results and second order results, with the second order results being more accurate, as expected. The maximum difference between the linear theory curve and the second order A502i curve amounts to a value of 2.5% right at mid-chord. The gap between the two curves from .25 chord to .75 chord were the result of thin panel density in that region.

Figure 4.2 shows excellent agreement with the linear theory curve. The A502i values of Cp for the linear and second order analysis are virtually identical. There are small deviations from linear theory near the leading and trailing edges, but this is expected due to numerical error associated with the discontinuity A502i would encounter right on the leading or trailing edges.

B. DELTAWING DISCUSSION

Reference 9 provides data on Mach distribution, using approximated linear theory, over a deltawing of the configuration discussed in section II-D. This simple geometry provided another test of A502i's capabilities. Figures 4.3 and 4.5 show the A502i results for the subsonic and supersonic case, while Figures 4.4 and 4.6 reflect the results from Ref. 9. For both cases, good agreement is found with the linear theory, with A502i's subsonic analysis being physically more accurate than the approximate linear theory, while A502i's supersonic analysis is not as physically accurate.

A comparison of Figures 4.3 and 4.4 reveals several points of interest. The Mach contour representing the free-stream value is given by the dashed line. All lines outside the dashed line represent areas where the Mach value is less than free-stream, and inside the dashed line is where the Mach value is more than free-stream. The location of where the free-stream Mach contour, in Figure 4.3, intersects the centerline agrees very well with Figure 4.4. However, Figure 4.4 does not have the contour extending all the way to the

tip. This is a physical limitation of the approximate theory used in Figure 4.4 and A502i is giving a more realistic solution. Figure 4.4 suggests that the peak Mach value occurs at approximately two-thirds chord along the centerline. The A502i results show the peak Mach contour occurring out midway along the semi-span. Those Mach values are less than 1% larger than the yellow Mach contour surrounding it, and can be attributed to how the panel density increases with movement towards the wingtip. A502i performed very well for this subsonic case.

A comparison of Figures 4.5 and 4.6 shows that A502i did not perform as well as in the subsonic case. Again, the contour representing the free-stream value of Mach =1.414 is given by the dashed line. All lines forward are below free-stream and all lines aft are above free-stream. Figure 4.6 shows the intersection of the free-stream Mach contour on the centerline occurring at approximately 39% chord, which is in excellent agreement with A502i's result. Figure 4.6 shows the peak Mach value occurring at the trailing edge on the centerline. This makes more physical sense than the results that A502i yielded. The maximum thickness of the deltawing occurs along the centerline, allowing for greater expansion. The discrepancy may be attributable to panel density and accumulation of numerical error. A close study of the A502i results reveals some discontinuities along the column of panels out at the wing-tip which would have adversely affected the solution and caused errors to propagate along the semi-span.

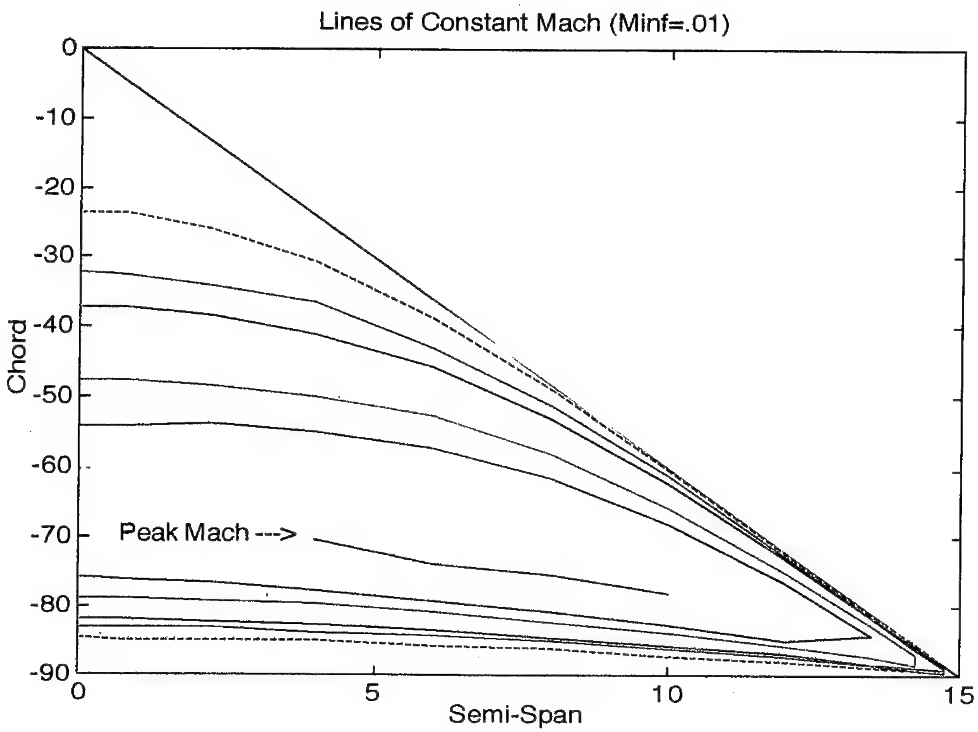

Figure 4.3 A502i Mach Contour Plot (M_∞=.01)

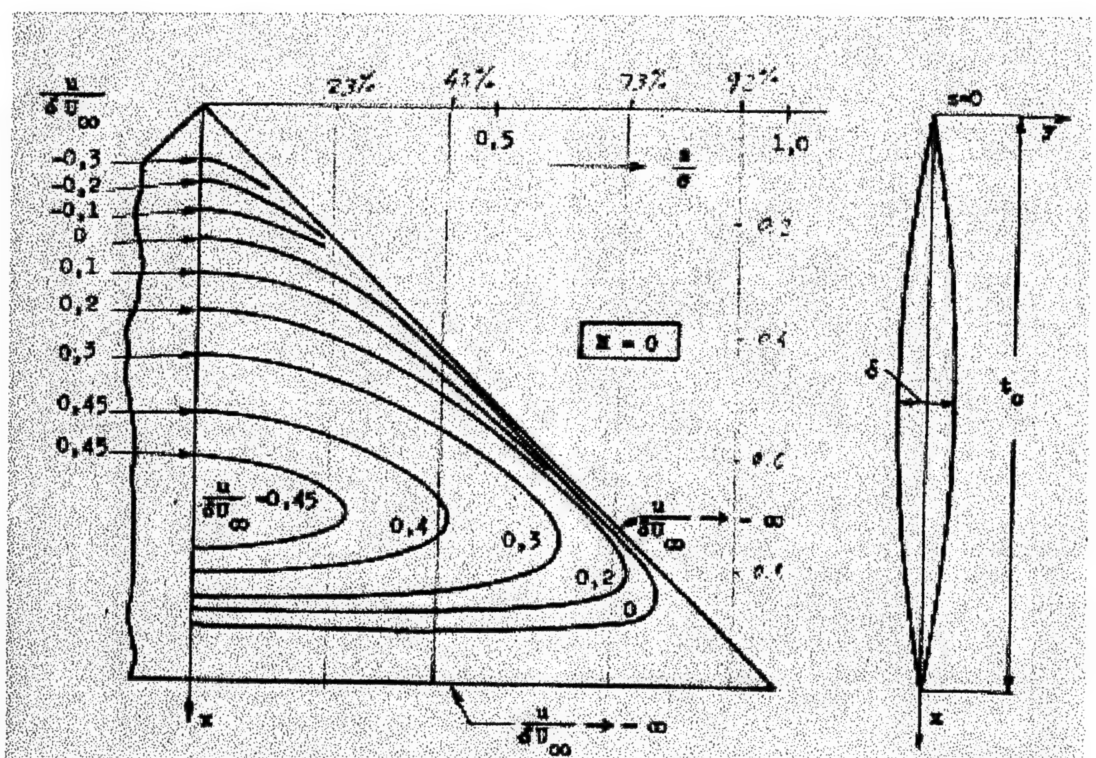

Figure 4.4 Approximate Linear Theory [Ref. 9] M_∞=0

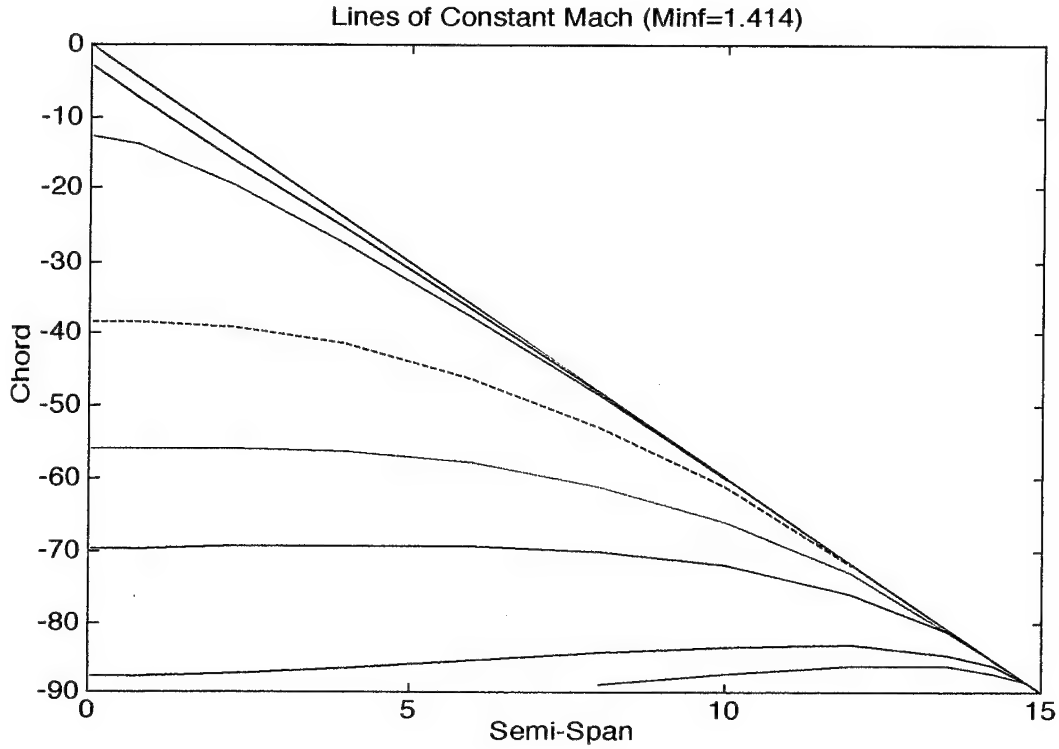

Figure 4.5 A502i Mach Contour Plot (M_∞=1.414)

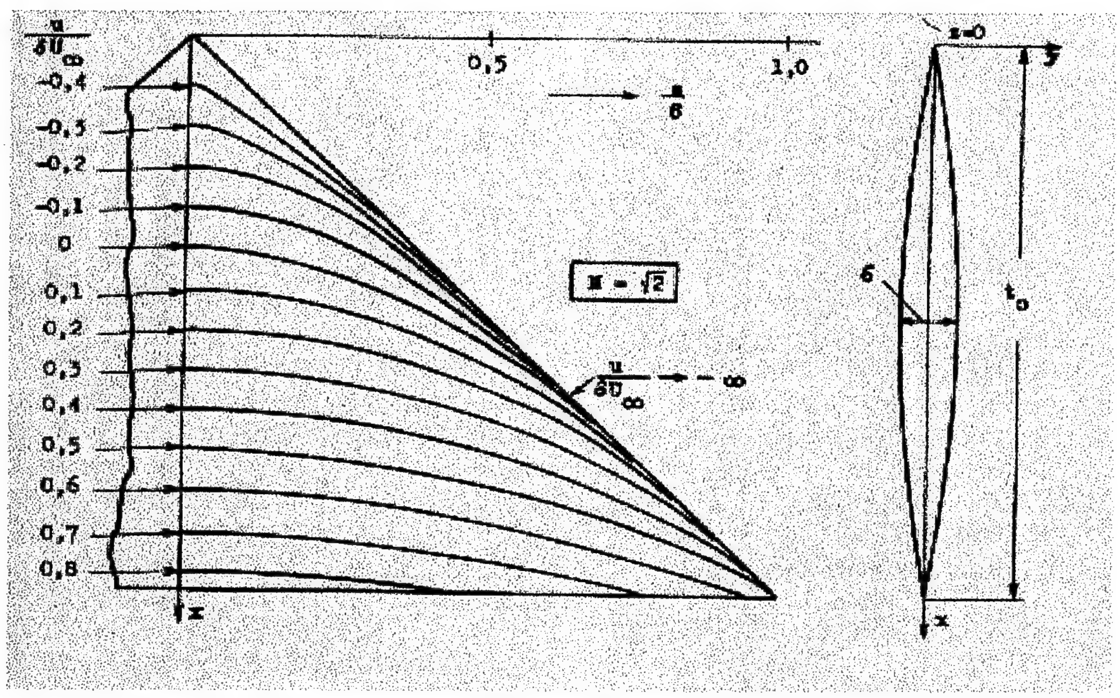

Figure 4.6 Approximate Linear Theory [Ref. 9] M_∞=1.414

C. GBU-24 FREE-STREAM (NO CANARDS) DISCUSSION

A free-stream measurement of separation forces on the GBU-24, without canards, was conducted in a wind tunnel for various Mach numbers from .8 to 1.2 [Ref. 7]. Since A502i uses linear potential theory, the model of the GBU-24, without canards, was evaluated at both Mach .8 and 1.2, avoiding the transonic regime, to ascertain the accuracy of the code with the given geometry. Normal forces and pitching moments for both cases are plotted and compared to the wind tunnel data.

1. Subsonic Case (M_∞=0.8)

The GBU-24 model, without the canards, was run for angles of attack varying from -10 to +10 degrees in two degree increments. Values much higher than that ran into wake modelling problems as the wake's angle relative to the free-stream was getting large enough that results would become questionable, and remodelling the wake was too difficult for such a complex geometry. The results of the A502i analysis are displayed in Figures 4.7 and 4.8. For angles of attack between -4 and +4 degrees, A502i does a good job of predicting the separation forces. The pitching moment, which happens to be unstable without the canards, is approximately linear over the -4 to +4 degree range and is the limiting factor to the models accuracy. The normal force is approximately linear over a wider range, and A502i does a good job of predicting the normal forces from -6 to +6 degrees.

2. Supersonic Case (M_∞=1.2)

The results for the subsonic case demonstrated that the effective range of angle of attack that A502i needed to explore was from -6 to +6 degrees. Figures 4.9 and 4.10 plot the comparison of wind tunnel data versus A502i results for pitching moment and normal force. The results for the supersonic case are slightly better than that of the subsonic case. The actual pitching moment of the GBU-24 is approximately linear over a wider angle of

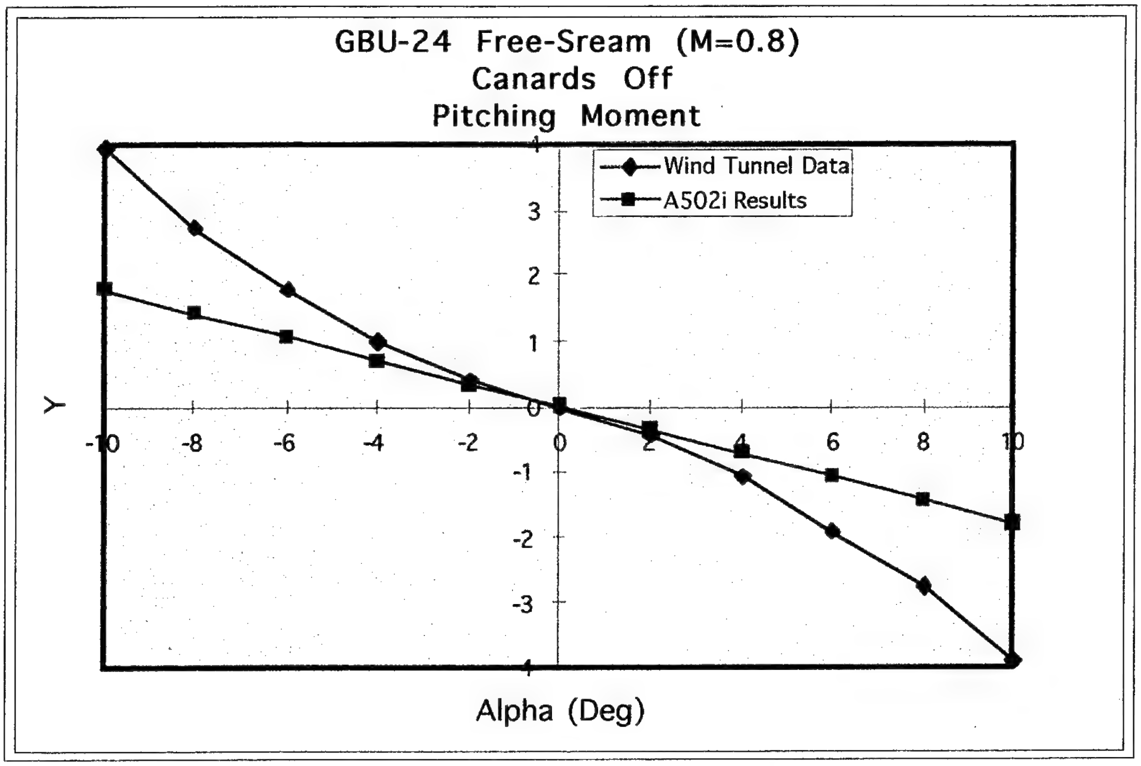

Figure 4.7 Comparison of Pitching Moments

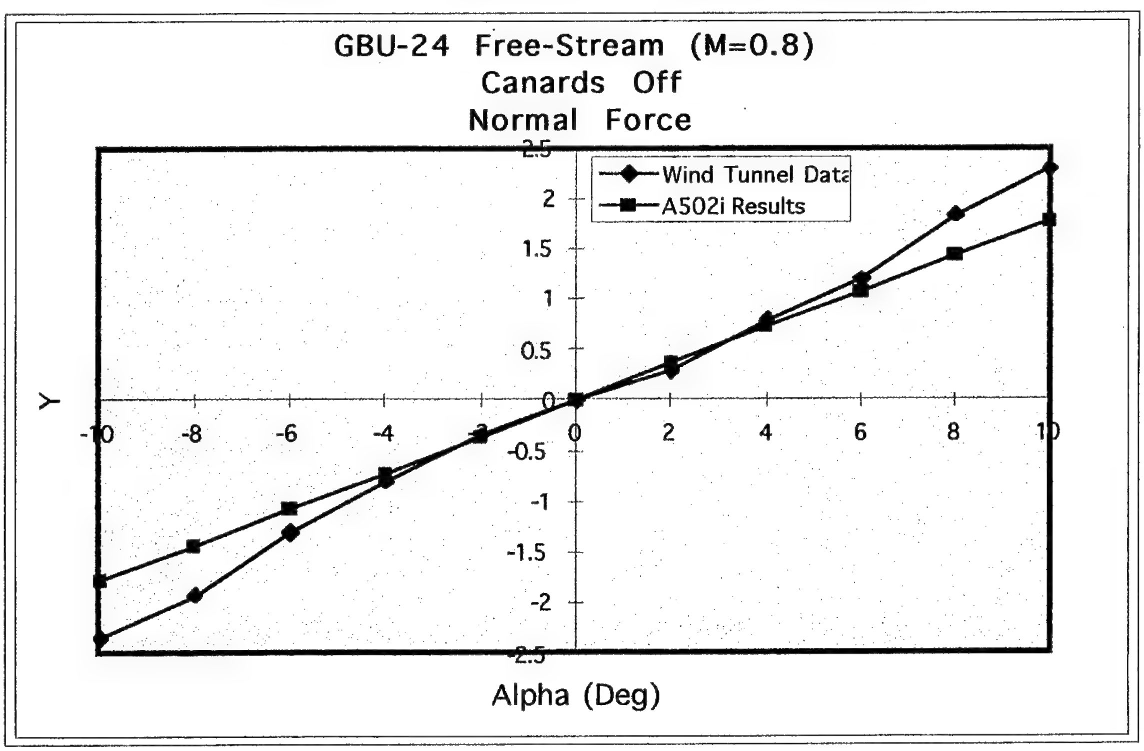

Figure 4.8 Comparison of Normal Forces

attack region, but fluctuations in the data at -6 and +6 degrees means that the model is still only viable from -4 to +4 degrees. The normal force line is nearly linear from -10 to +10 degrees and extrapolating the A502i results out to 10 degrees would still yield good predictions.

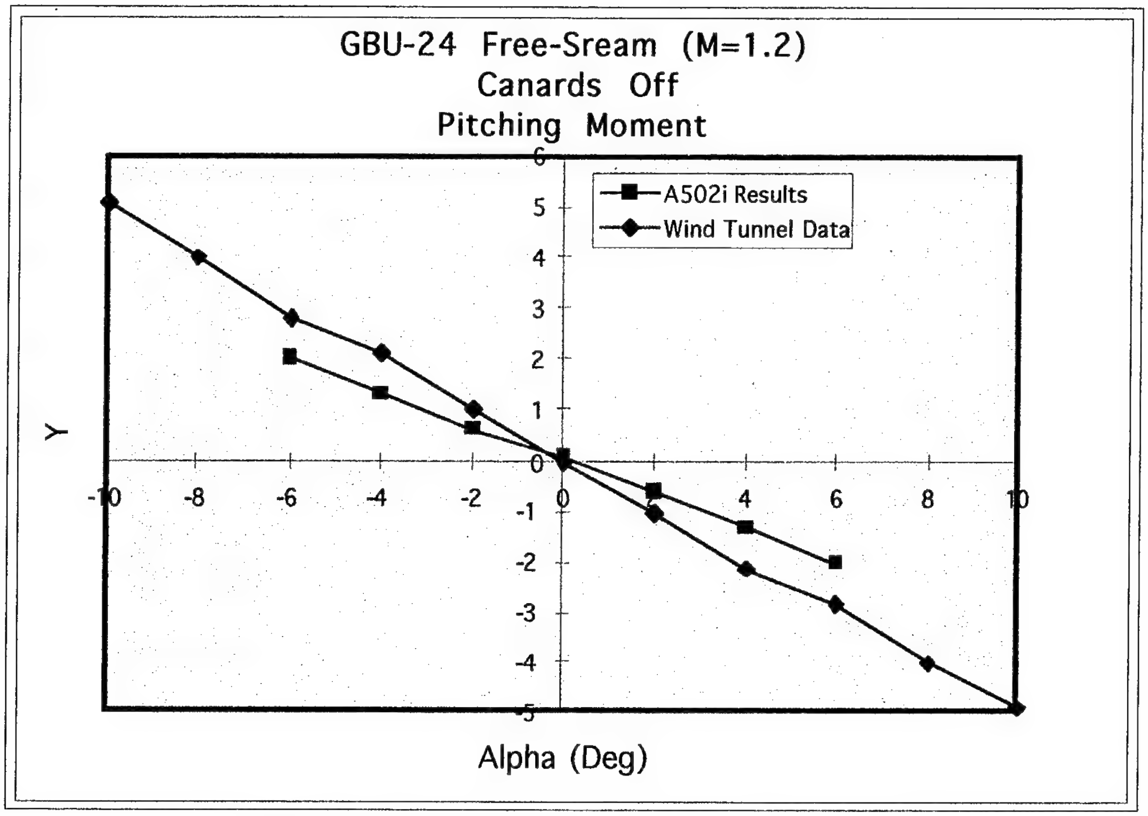

Figure 4.9 Comparison of Pitching Moments

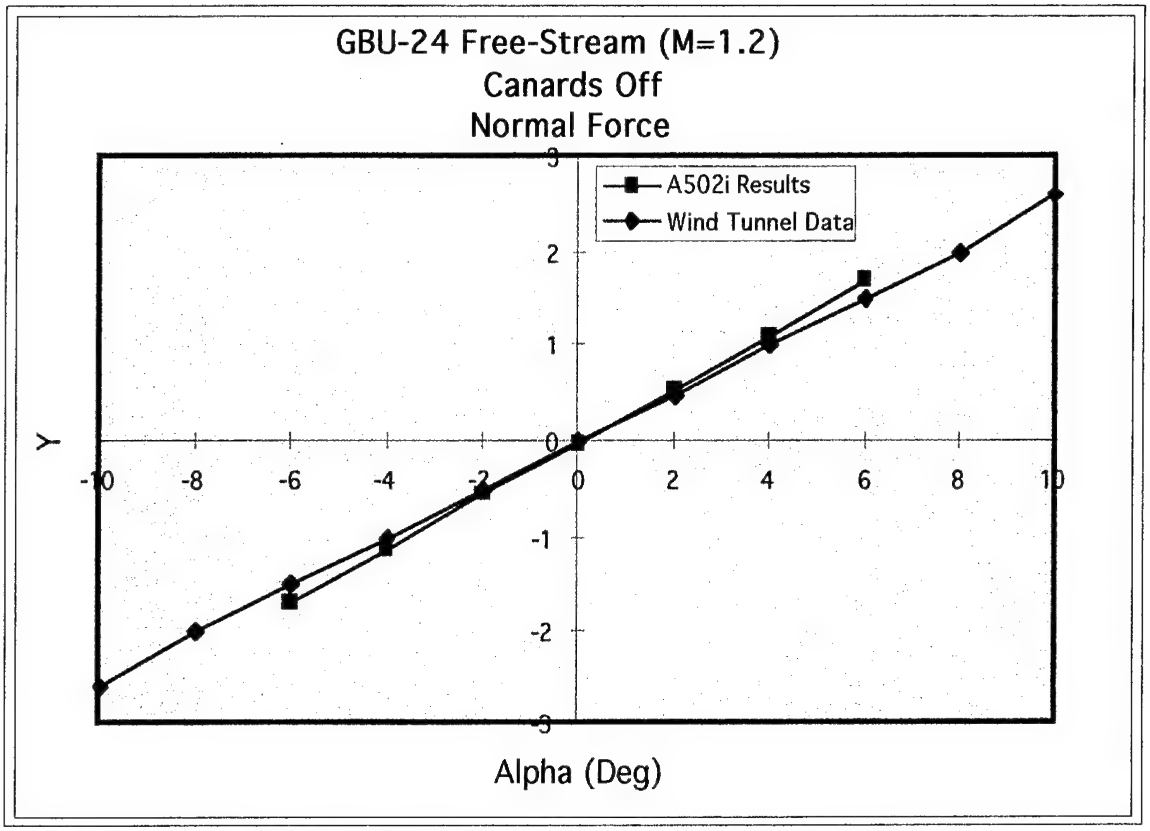

Figure 4.10 Comparison of Normal Forces

D. GBU-24 FREE-STREAM (WITH CANARDS) DISCUSSION

As in the case with no canards, free-stream measurements of the separation forces on GBU-24 were taken from Mach .8 to 1.2 in a wind tunnel [Ref. 7]. Again, due to the limitations of linear theory inherent in the code, an analysis was done for Mach numbers of .8 and 1.2 to minimize transonic effects. Even with the more complex geometry, A502i does an accurate job of predicting the separation forces over the range of angles of attack that are approximately linear.

1. Subsonic Case (M_∞=0.8)

The GBU-24 model, with canards, was run in two degree increments of angle of attack from -10 to +10. The wake modelling limitation, as well as reviewing the data from the wind tunnel measurements [Ref. 7] showed the non-linearity of the separation forces at

the higher values of angle of attack, precluded any attempts to predict forces beyond the aforementioned angle of attack interval. The results of the A502i analysis are displayed in Figures 4.11 and 4.12. The addition of the canards makes the pitching moment stable, but linear over a smaller region than without the canards. A502i gave accurate results from -2 to +2 degrees angle of attack when predicting pitching moment. The prediction of normal forces fared better, showing accurate results from -3 to +3 degrees angle of attack.

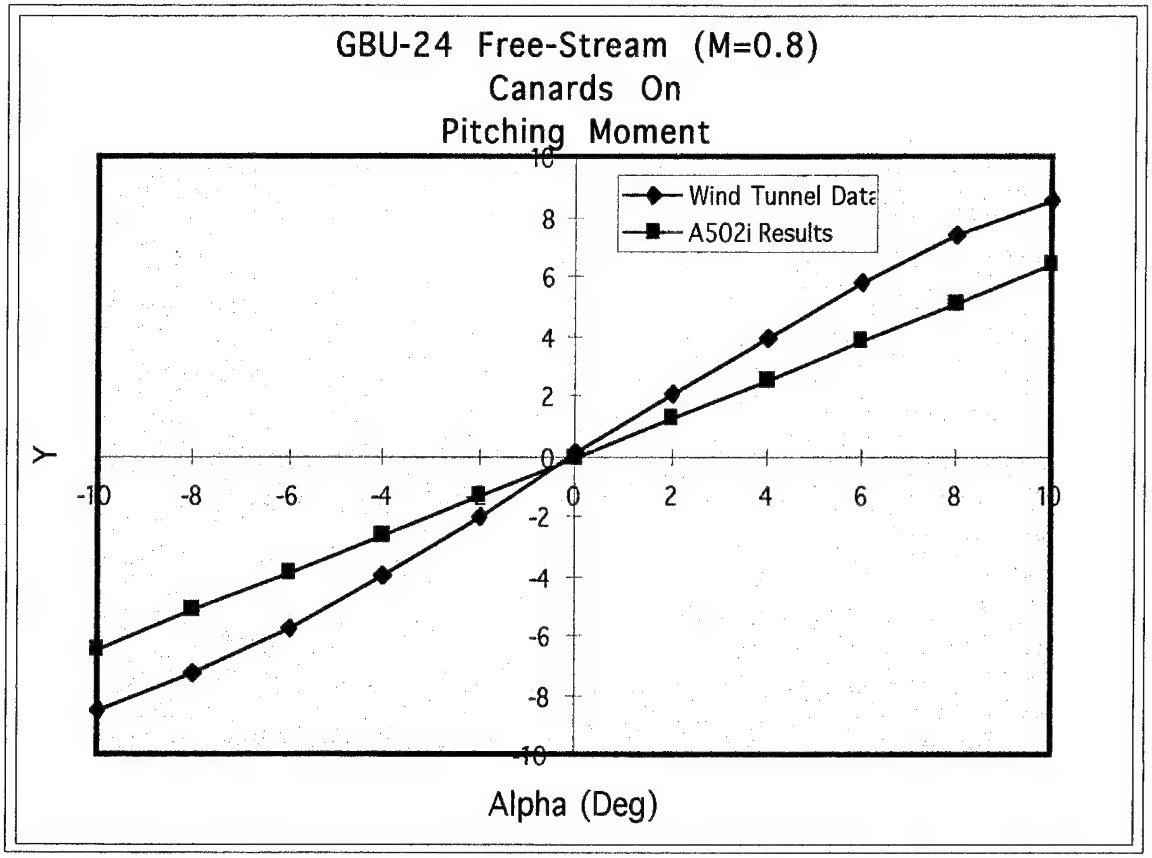

Figure 4.11 Comparison of Pitching Moments

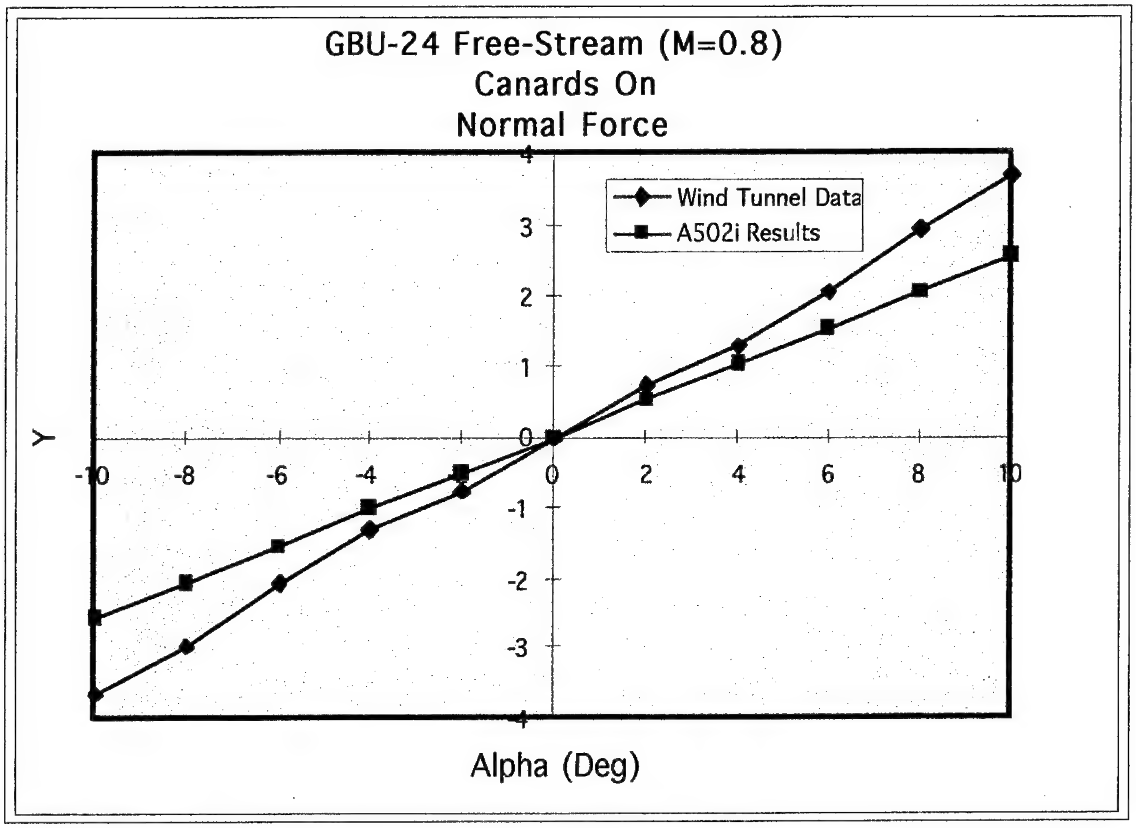

Figure 4.12 Comparison of Normal Forces

2. Supersonic Case (M_∞=1.2)

As in the case with no canards, the region of accuracy, with the model used, was assumed to be less than + or - 10 degrees angle of attack. Cases were run from -6 to +6 degrees angle of attack in two degree increments. A comparison of A502i results with wind tunnel data is shown in Figures 4.13 and 4.14. For both the pitching moment and the normal force, A502i does a much better job of prediction then when subsonic. The wind tunnel data is nearly linear in both pitch moment and normal force from -8 to +8 degrees angle of attack. Extrapolating the A502i data out to + or - 8 degrees angle of attack, shows excellent agreement with the wind tunnel data.

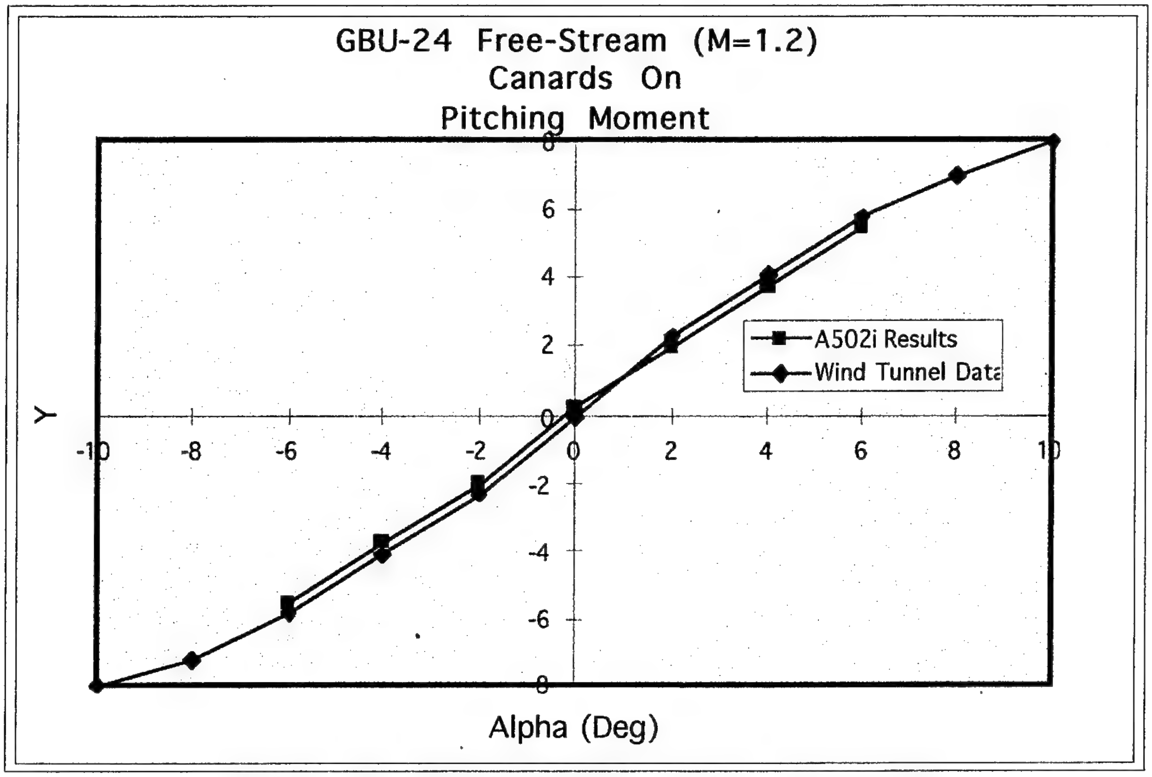

Figure 4.13 Comparison of Pitching Moments

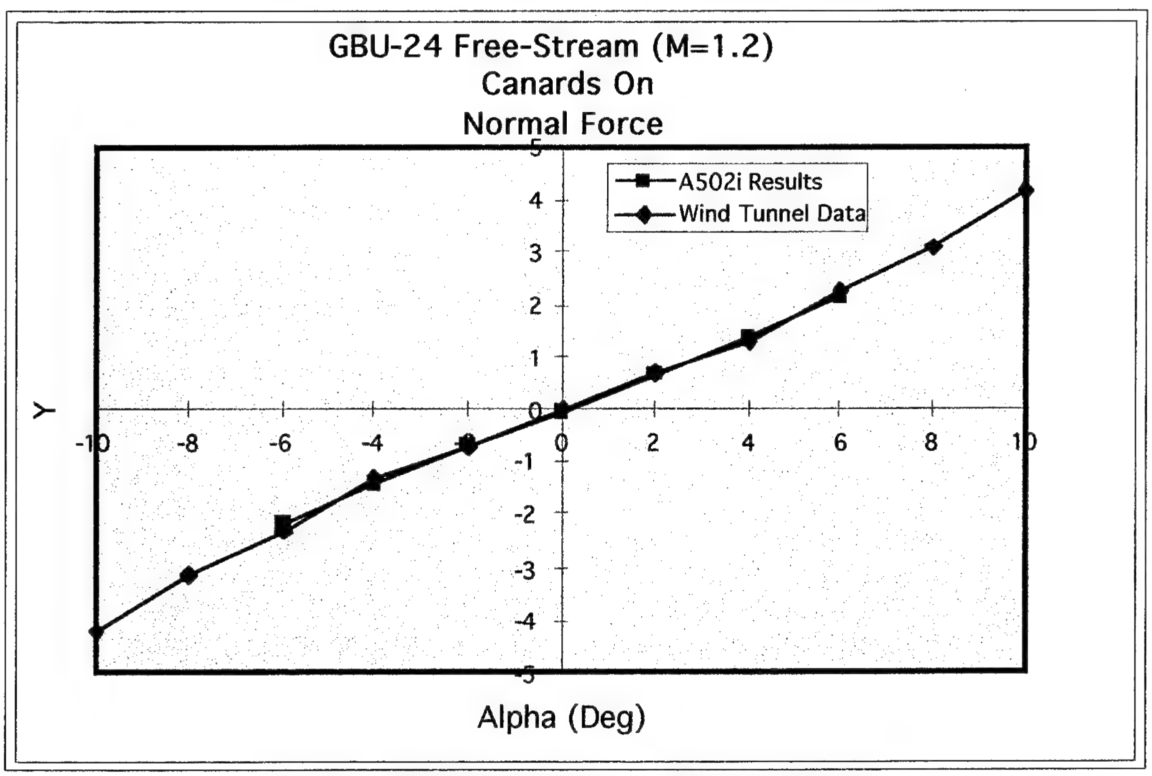

Figure 4.14 Comparison of Normal Forces

E. F-14 DISCUSSION

The GBU-24, without canards was located at station 3 of the F-14 via the NAVSEP code. In the process of running a solution, the combined geometries were found to have a total of 150 networks (A502i's maximum). The combined geometry had about 4,000 panels, far short of the 20,000 panel maximum, so there was room for more detailed modelling, but there was not a chance to insert the GBU-24, with canards, into the F-14's flow field and analyze the forces on the bomb. The geometry with the canardless bomb ran to a solution that appeared to be valid, so there is a high degree of confidence that if the number of networks could be reduced to allow the GBU-24, with canards, to be inserted into the F-14 flow field, the code would yield accurate predictions at small angles of attack on the forward stations. To reduce the total number of networks by combining existing networks would have required a large time investment and the use of MACGS, which the department currently does not possess, the two reasons why it was not done. Figure 4.15 shows a Mach distribution of the solution of the canardless bomb and F-14 at Mach = 0.8 and 0 degrees angle of attack

F. POST-PROCESSING DISCUSSION

The Mach values for the subsonic case of the GBU-24, with canards, at 4 degrees angle of attack, were extracted from the ft13 file. These values, used in conjunction with RAID are shown in Figures 4.16 and 4.17. The color distribution over the nose in Figure 4.16 indicates that the bomb is at an angle of attack, and scanning the rest of the model showed no discontinuous solutions, which is generally represented in A502i by a Mach value of 0 or 1,000. The visual representation is a quick way of telling if A502i ran an accurate solution. The only other way is to individually check the Mach or Cp values of each panel in the ft13 file or the arbitrarily named output file. The other point of interest in Figure 4.16 is the lack of panel density along the mid-section of the bomb. The goal, in the

case of stores separation prediction, is to have as simple a model as possible that still gives accurate predictions. The fewer the number of panels, the shorter the run time. The fact that A502i is a higher order panel method allows the luxury of using fewer panels. Figure 4.17 highlights the approach used to take into account separation effects as discussed on page 16.

Figure 4.15 Mach Distribution over GBU-24 and F-14 (M_∞=0.8, alpha=0°)

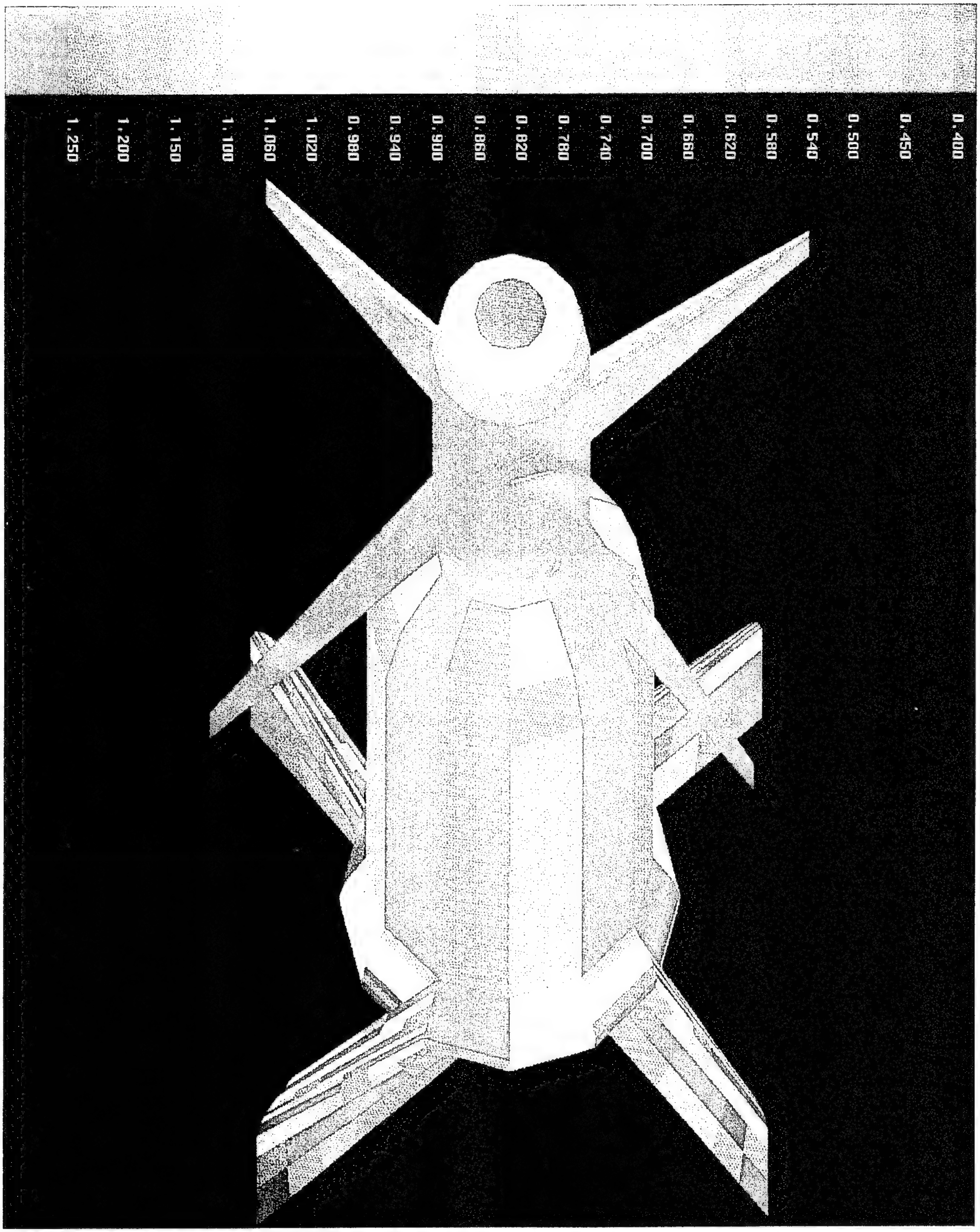

Figure 4.16 Mach Distribution over GBU-24 (M_∞=0.8, alpha=4°)

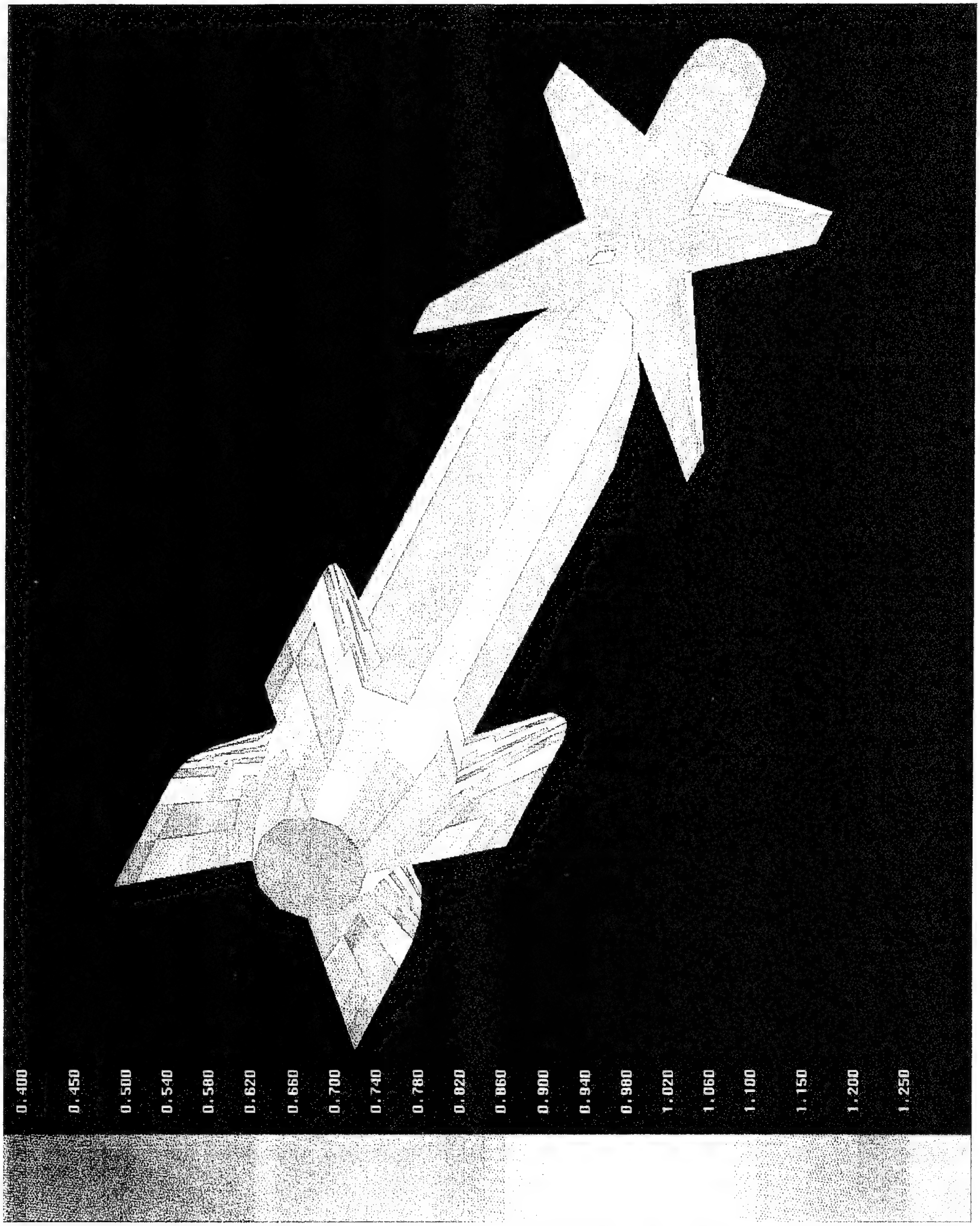

Figure 4.17 Mach Distribution over GBU-24 ($M_\infty=0.8$, alpha=4°)

V. SUMMARY AND CONCLUSIONS

The main goal of this analysis is to determine the accuracy of A502i on both simple geometries and complex geometries. To accomplish this, A502i is compared with results available from linear theory and wind tunnel experiments. This allows conclusions to be drawn on the capabilities as well as the limitations of A502i.

In general, A502i can accurately predict flow properties, forces and moments on simple and complex geometries at low angles of attack. The predictions are valid over a wide Mach range, from 0 up to and including 0.8 and from 1.2 and above. The supersonic solutions are available due to A502i's higher order capabilities.

The limitations of A502i are consistent with most panel methods. A502i cannot predict flow dominated by viscous, separated or transonic effects. It cannot predict flow with different total pressures, such as flow properties inside a jet plume or a propeller slipstream swirl. The biggest shortcoming of A502i is its inability to handle unsteady cases and automatically determine wake shapes.

Experience or knowledge of the flow properties around the geometry being tested is important in building an accurate model. An accurate model may not be physically accurate. Flight test results revealed a yawing moment on the GBU-24 that was not discovered in wind tunnel experiments when the bomb was carried on an aft station. The yawing moment may be caused by the fact that the canards are not fixed, but spring-damped. A502i predictions would not be accurate without inputting a moment to simulate the deflection of the canards, since the canards are fixed by the geometry. A502i, while a powerful tool in terms of cost savings and time, cannot completely substitute for wind tunnel experiments and flight tests, as constructing a complex geometry to exact physical specifications will probably not yield accurate predictions.

APPENDIX A. GBU-24 OUPUT FILE (INPUT FILE PORTION)


```
 ****************************************************************************************************

   dynamic memory management initialization

   max no. levels          15   max no. arrays        200   maximum scratch storage     900000   total storage provided   900000
     addr(maplev)           0     addr(maplws)          0     addr(scratch storage)          1

 ****************************************************************************************************
  wopen call on unit    1  blocks:    10   status:     0
  wopen call on unit    2  blocks:    10   status:     0
  wopen call on unit    3  blocks:    10   status:     0
1

 *****************************************************************************
 *                                                                           *
 *                      a502 - pan-air technology program                    *
 *                                                                           *
 *                potential flow about arbitrary configurations              *
 *                version id = ht2 (12 feb 92) boeing ver 100                *
 *                                                                           *
 *                                 07-Mar-9                                  *
 *                                                                           *
 *                                                                           *
 * GBU-24 FREESTREAM M=0.8
 * $SOLUTION
 *                                                                           *
 *                                                                           *
 *                                                                           *
 *****************************************************************************
1
0*b*input-da




                           - list of a502 input data cards -
     1 $TITLE
     2 GBU-24 FREESTREAM M=0.8
     3 $SOLUTION
     4 $SYMMETRY
     5 = MISYMM   MJSYMM
     6 0.         0.
     7 $MACH NUMBER
     8 =AMACH
     9 .8
    10 $CASES
    11 =NCASE
    12 1.
    13 $ANGLES-OF-ATTACK
    14 =ALPC
    15 2.
    16 =ALPHA(1)
```

```
2.
$PRINTOUT OPTIONS
=ISINGS    IGEOMP    ISINGP    ICONTP    IBCONP    IEDGEP
0.         0.        0.        1.        0.        0.
=IPRAIC    NEXDGN    IOUTPR    IFMCPR
0.         0.        0.        0.
$REFERENCES FOR ACCUMULATED FORCES AND MOMENTS
=XREF      YREF      ZREF      NREF
100.716    0.0       0.0       1.
=SREF      BREF      CREF      DREF
165.1248   1.0       14.496    14.496
$POINTS NETWORK =     ZCAN4
1.0
2.0
        9.0        9.0
     45.236      3.138    -2.324    42.548     3.138    -2.324
     39.859      3.138    -2.324    37.171     3.138    -2.324
     34.483      3.138    -2.324    31.795     3.138    -2.324
     29.107      3.138    -2.324    26.418     3.138    -2.324
     23.730      3.138    -2.324
     45.183      4.642    -3.583    42.732     4.642    -3.582
     40.281      4.642    -3.582    37.830     4.642    -3.582
     35.380      4.642    -3.581    32.929     4.642    -3.581
     30.478      4.642    -3.581    28.027     4.642    -3.580
     25.576      4.642    -3.580
     45.130      6.146    -4.841    42.917     6.146    -4.840
     40.703      6.146    -4.840    38.489     6.146    -4.839
     36.276      6.146    -4.839    34.063     6.146    -4.838
     31.849      6.146    -4.837    29.635     6.146    -4.837
     27.422      6.145    -4.836
     45.077      7.650    -6.100    43.101     7.650    -6.099
     41.125      7.650    -6.098    39.149     7.650    -6.097
     37.173      7.650    -6.096    35.196     7.650    -6.095
     33.220      7.650    -6.094    31.244     7.649    -6.093
     29.268      7.649    -6.092
     45.025      9.155    -7.358    43.286     9.155    -7.357
     41.547      9.154    -7.355    39.808     9.154    -7.354
     38.069      9.154    -7.353    36.330     9.154    -7.352
     34.591      9.153    -7.350    32.853     9.153    -7.349
     31.114      9.153    -7.348
     44.972     10.659    -8.616    43.470    10.659    -8.615
     41.969     10.659    -8.613    40.467    10.658    -8.612
     38.966     10.658    -8.610    37.464    10.658    -8.608
     35.963     10.658    -8.607    34.461    10.657    -8.605
     32.959     10.657    -8.603
     44.919     12.163    -9.875    43.655    12.163    -9.873
     42.390     12.163    -9.871    41.126    12.162    -9.869
     39.862     12.162    -9.867    38.598    12.162    -9.865
     37.334     12.161    -9.863    36.069    12.161    -9.861
     34.805     12.161    -9.859
     44.866     13.668   -11.133    43.839    13.667   -11.131
     42.812     13.667   -11.129    41.785    13.667   -11.127
     40.759     13.666   -11.124    39.732    13.666   -11.122
     38.705     13.665   -11.120    37.678    13.665   -11.117
     36.651     13.665   -11.115
     44.813     15.172   -12.392    44.024    15.172   -12.389
     43.234     15.171   -12.387    42.445    15.171   -12.384
```

```
      41.655     15.170    -12.381     40.866     15.170    -12.379
      40.076     15.169    -12.376     39.287     15.169    -12.374
      38.497     15.168    -12.371
 $POINTS NETWORK =     ZCAN3
 1.0
 2.0
         9.0        9.0
      45.236     -2.324     -3.138     42.548     -2.324     -3.138
      39.859     -2.324     -3.138     37.171     -2.324     -3.138
      34.483     -2.324     -3.138     31.795     -2.324     -3.138
      29.107     -2.324     -3.138     26.418     -2.324     -3.138
      23.730     -2.324     -3.138
      45.183     -3.583     -4.642     42.732     -3.582     -4.642
      40.281     -3.582     -4.642     37.830     -3.582     -4.642
      35.380     -3.581     -4.642     32.929     -3.581     -4.642
      30.478     -3.581     -4.642     28.027     -3.580     -4.642
      25.576     -3.580     -4.642
      45.130     -4.841     -6.146     42.917     -4.840     -6.146
      40.703     -4.840     -6.146     38.489     -4.839     -6.146
      36.276     -4.839     -6.146     34.063     -4.838     -6.146
      31.849     -4.837     -6.146     29.635     -4.837     -6.146
      27.422     -4.836     -6.145
      45.077     -6.100     -7.650     43.101     -6.099     -7.650
      41.125     -6.098     -7.650     39.149     -6.097     -7.650
      37.173     -6.096     -7.650     35.196     -6.095     -7.650
      33.220     -6.094     -7.650     31.244     -6.093     -7.649
      29.268     -6.092     -7.649
      45.025     -7.358     -9.155     43.286     -7.357     -9.155
      41.547     -7.355     -9.154     39.808     -7.354     -9.154
      38.069     -7.353     -9.154     36.330     -7.352     -9.154
      34.591     -7.350     -9.153     32.853     -7.349     -9.153
      31.114     -7.348     -9.153
      44.972     -8.616    -10.659     43.470     -8.615    -10.659
      41.969     -8.613    -10.659     40.467     -8.612    -10.658
      38.966     -8.610    -10.658     37.464     -8.608    -10.658
      35.963     -8.607    -10.658     34.461     -8.605    -10.657
      32.959     -8.603    -10.657
      44.919     -9.875    -12.163     43.655     -9.873    -12.163
      42.390     -9.871    -12.163     41.126     -9.869    -12.162
      39.862     -9.867    -12.162     38.598     -9.865    -12.162
      37.334     -9.863    -12.161     36.069     -9.861    -12.161
      34.805     -9.859    -12.161
      44.866    -11.133    -13.668     43.839    -11.131    -13.667
      42.812    -11.129    -13.667     41.785    -11.127    -13.667
      40.759    -11.124    -13.666     39.732    -11.122    -13.666
      38.705    -11.120    -13.665     37.678    -11.117    -13.665
      36.651    -11.115    -13.665
      44.813    -12.392    -15.172     44.024    -12.389    -15.172
      43.234    -12.387    -15.171     42.445    -12.384    -15.171
      41.655    -12.381    -15.170     40.866    -12.379    -15.170
      40.076    -12.376    -15.169     39.287    -12.374    -15.169
      38.497    -12.371    -15.168
 $POINTS NETWORK =     ZCAN1
 1.0
 2.0
         9.0        9.0
      45.236      2.324      3.138     42.548      2.324      3.138
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39.859    2.324    3.138   37.171    2.324    3.138
34.483    2.324    3.138   31.795    2.324    3.138
29.107    2.324    3.138   26.418    2.324    3.138
23.730    2.324    3.138
45.183    3.583    4.642   42.732    3.582    4.642
40.281    3.582    4.642   37.830    3.582    4.642
35.380    3.581    4.642   32.929    3.581    4.642
30.478    3.581    4.642   28.027    3.580    4.642
25.576    3.580    4.642
45.130    4.841    6.146   42.917    4.840    6.146
40.703    4.840    6.146   38.489    4.839    6.146
36.276    4.839    6.146   34.063    4.838    6.146
31.849    4.837    6.146   29.635    4.837    6.146
27.422    4.836    6.145
45.077    6.100    7.650   43.101    6.099    7.650
41.125    6.098    7.650   39.149    6.097    7.650
37.173    6.096    7.650   35.196    6.095    7.650
33.220    6.094    7.650   31.244    6.093    7.649
29.268    6.092    7.649
45.025    7.358    9.155   43.286    7.357    9.155
41.547    7.355    9.154  '39.808    7.354    9.154
38.069    7.353    9.154   36.330    7.352    9.154
34.591    7.350    9.153   32.853    7.349    9.153
31.114    7.348    9.153
44.972    8.616   10.659   43.470    8.615   10.659
41.969    8.613   10.659   40.467    8.612   10.658
38.966    8.610   10.658   37.464    8.608   10.658
35.963    8.607   10.658   34.461    8.605   10.657
32.959    8.603   10.657
44.919    9.875   12.163   43.655    9.873   12.163
42.390    9.871   12.163   41.126    9.869   12.162
39.862    9.867   12.162   38.598    9.865   12.162
37.334    9.863   12.161   36.069    9.861   12.161
34.805    9.859   12.161
44.866   11.133   13.668   43.839   11.131   13.667
42.812   11.129   13.667   41.785   11.127   13.667
40.759   11.124   13.666   39.732   11.122   13.666
38.705   11.120   13.665   37.678   11.117   13.665
36.651   11.115   13.665
44.813   12.392   15.172   44.024   12.389   15.172
43.234   12.387   15.171   42.445   12.384   15.171
41.655   12.382   15.170   40.866   12.379   15.170
40.076   12.376   15.169   39.287   12.374   15.169
38.497   12.371   15.168
$POINTS NETWORK =     ZCAN2
1.0
2.0
   9.0      9.0
45.236   -3.138    2.324   42.548   -3.138    2.324
39.859   -3.138    2.324   37.171   -3.138    2.324
34.483   -3.138    2.324   31.795   -3.138    2.324
29.107   -3.138    2.324   26.418   -3.138    2.324
23.730   -3.138    2.324
45.183   -4.642    3.583   42.732   -4.642    3.582
40.281   -4.642    3.582   37.830   -4.642    3.582
35.380   -4.642    3.581   32.929   -4.642    3.581
30.478   -4.642    3.581   28.027   -4.642    3.580
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188     25.576   -4.642    3.580
189     45.130   -6.146    4.841    42.917   -6.146    4.840
190     40.703   -6.146    4.840    38.489   -6.146    4.839
191     36.276   -6.146    4.839    34.063   -6.146    4.838
192     31.849   -6.146    4.837    29.635   -6.146    4.837
193     27.422   -6.145    4.836
194     45.077   -7.650    6.100    43.101   -7.650    6.099
195     41.125   -7.650    6.098    39.149   -7.650    6.097
196     37.173   -7.650    6.096    35.196   -7.650    6.095
197     33.220   -7.650    6.094    31.244   -7.649    6.093
198     29.268   -7.649    6.092
199     45.025   -9.155    7.358    43.286   -9.155    7.357
200     41.547   -9.154    7.355    39.808   -9.154    7.354
201     38.069   -9.154    7.353    36.330   -9.154    7.352
202     34.591   -9.153    7.350    32.853   -9.153    7.349
203     31.114   -9.153    7.348
204     44.972  -10.659    8.616    43.470  -10.659    8.615
205     41.969  -10.659    8.613    40.467  -10.658    8.612
206     38.966  -10.658    8.610    37.464  -10.658    8.608
207     35.963  -10.658    8.607    34.461  -10.657    8.605
208     32.959  -10.657    8.603
209     44.919  -12.163    9.875    43.655  -12.163    9.873
210     42.390  -12.163    9.871    41.126  -12.162    9.869
211     39.862  -12.162    9.867    38.598  -12.162    9.865
212     37.334  -12.161    9.863    36.069  -12.161    9.861
213     34.805  -12.161    9.859
214     44.866  -13.668   11.133    43.839  -13.667   11.131
215     42.812  -13.667   11.129    41.785  -13.667   11.127
216     40.759  -13.666   11.124    39.732  -13.666   11.122
217     38.705  -13.665   11.120    37.678  -13.665   11.117
218     36.651  -13.665   11.115
219     44.813  -15.172   12.392    44.024  -15.172   12.389
220     43.234  -15.171   12.387    42.445  -15.171   12.384
221     41.655  -15.170   12.382    40.866  -15.170   12.379
222     40.076  -15.169   12.376    39.287  -15.169   12.374
223     38.497  -15.168   12.371
224 $POINTS NETWORK =    ZNOSF
225 1.0
226 1.0
227        4.0     13.0
228      8.499    0.000    3.999     2.498    0.000    3.564
229      0.482    0.000    1.853     0.000    0.000    0.000
230      8.499    1.995    3.465     2.498    1.778    3.088
231      0.482    0.924    1.605     0.000    0.000    0.000
232      8.499    3.463    2.007     2.498    3.086    1.788
233      0.482    1.604    0.930     0.000    0.000    0.000
234      8.499    3.999    0.000     2.498    3.565    0.000
235      0.482    1.853    0.000     0.000    0.000    0.000
236      8.499    3.463   -2.007     2.498    3.086   -1.789
237      0.482    1.604   -0.930     0.000    0.000    0.000
238      8.499    2.007   -3.463     2.498    1.789   -3.087
239      0.482    0.930   -1.604     0.000    0.000    0.000
240      8.499    0.000   -4.000     2.498    0.000   -3.565
241      0.482    0.000   -1.853     0.000    0.000    0.000
242      8.499   -2.007   -3.463     2.498   -1.788   -3.086
243      0.482   -0.930   -1.604     0.000    0.000    0.000
244      8.499   -3.463   -2.007     2.498   -3.086   -1.789
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       0.482    -1.604    -0.930     0.000     0.000     0.000
       8.499    -3.999     0.000     2.498    -3.565     0.000
       0.482    -1.853     0.000     0.000     0.000     0.000
       8.499    -3.463     2.007     2.498    -3.086     1.788
       0.482    -1.604     0.930     0.000     0.000     0.000
       8.499    -1.995     3.464     2.498    -1.778     3.088
       0.482    -0.924     1.605     0.000     0.000     0.000
       8.499     0.000     3.999     2.498     0.000     3.565
       0.482     0.000     1.853     0.000     0.000     0.000
$POINTS NETWORK =  ZNOSAFT
1.0
1.0
        13.0       2.0
       8.499     0.000     3.999     8.499     1.995     3.465
       8.499     3.463     2.007     8.499     3.999     0.000
       8.499     3.463    -2.007     8.499     2.007    -3.463
       8.499     0.000    -4.000     8.499    -2.007    -3.463
       8.499    -3.463    -2.007     8.499    -3.999     0.000
       8.499    -3.463     2.007     8.499    -1.995     3.464
       8.499     0.000     3.999
      21.730     0.000     3.999    21.730     1.995     3.465
      21.730     3.463     2.007    21.730     3.999     0.000
      21.730     3.463    -2.007    21.730     2.007    -3.463
      21.730     0.000    -4.000    21.730    -2.007    -3.463
      21.730    -3.463    -2.007    21.730    -3.999     0.000
      21.730    -3.463     2.007    21.730    -1.995     3.465
      21.730     0.000     3.999
$POINTS NETWORK = ZCANFWD1
1.0
1.0
         3.0      13.0
      23.730    -3.138     2.324    22.730    -3.300     2.165
      21.730    -3.463     2.007
      23.730    -1.995     3.465    22.730    -1.995     3.465
      21.730    -1.995     3.465
      23.730     0.000     4.000    22.730     0.000     4.000
      21.730     0.000     3.999
      23.730     2.324     3.138    22.730     2.159     3.301
      21.730     1.995     3.465
      23.730     3.463     2.007    22.730     3.463     2.007
      21.730     3.463     2.007
      23.730     4.000     0.000    22.730     4.000     0.000
      21.730     3.999     0.000
      23.730     3.138    -2.324    22.730     3.301    -2.166
      21.730     3.463    -2.007
      23.730     2.007    -3.464    22.730     2.007    -3.464
      21.730     2.007    -3.463
      23.730     0.000    -4.000    22.730     0.000    -4.000
      21.730     0.000    -4.000
      23.730    -2.324    -3.138    22.730    -2.165    -3.301
      21.730    -2.007    -3.463
      23.730    -3.463    -2.007    22.730    -3.463    -2.007
      21.730    -3.463    -2.007
      23.730    -4.000     0.000    22.730    -4.000     0.000
      21.730    -3.999     0.000
      23.730    -3.138     2.324    22.730    -3.300     2.165
      21.730    -3.463     2.007
```

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$POINTS NETWORK =     BODCAN1
1.
1.         0.         0.         0.         1.
4.         2.
      23.730     2.324      3.138     23.730     0.000      4.000
      23.730    -1.995      3.465     23.730    -3.138      2.324
      45.236     2.324      3.138     45.236     0.000      4.000
      45.236    -1.995      3.465     45.236    -3.138      2.324
$POINTS NETWORK =     BODCAN2
1.
1.         0.         0.         0.         1.
4.         2.
      23.730    -3.138      2.324     23.730    -4.000      0.000
      23.730    -3.463     -2.007     23.730    -2.324     -3.138
      45.236    -3.138      2.324     45.236    -4.000      0.000
      45.236    -3.463     -2.007     45.236    -2.324     -3.138
$POINTS NETWORK =     BODCAN3
1.
1.         0.         0.         0.         1.
4.         2.
      23.730    -2.324     -3.138     23.730     0.000     -4.000
      23.730     2.007     -3.464     23.730     3.138     -2.324
      45.236    -2.324     -3.138     45.236     0.000     -4.000
      45.236     2.007     -3.464     45.236     3.138     -2.324
$POINTS NETWORK =     BODCAN4
1.
1.         0.         0.         0.         1.
4.         2.
      23.730     3.138     -2.324     23.730     4.000      0.000
      23.730     3.463      2.007     23.730     2.324      3.138
      45.236     3.138     -2.324     45.236     4.000      0.000
      45.236     3.463      2.007     45.236     2.324      3.138
$POINTS NETWORK = ZCANAFT1
1.0
1.0        0.         0.         0.         1.
         3.0      13.0
      47.236    -3.463      2.007     46.236    -3.300      2.165
      45.236    -3.138      2.324
      47.236    -4.000      0.000     45.236    -4.000      0.000
      45.236    -4.000      0.000
      47.236    -3.463     -2.007     46.236    -3.463     -2.007
      45.236    -3.463     -2.007
      47.236    -2.007     -3.464     46.236    -2.166     -3.301
      45.236    -2.324     -3.138
      47.236     0.000     -4.000     46.236     0.000     -4.000
      45.236     0.000     -4.000
      47.236     2.007     -3.464     46.236     2.007     -3.464
      45.236     2.007     -3.464
      47.236     3.464     -2.007     46.236     3.301     -2.166
      45.236     3.138     -2.324
      47.236     4.000      0.000     46.236     4.000      0.000
      45.236     4.000      0.000
      47.236     3.463      2.007     46.236     3.463      2.007
      45.236     3.463      2.007
      47.236     1.995      3.465     46.236     2.159      3.301
      45.236     2.324      3.138
      47.236     0.000      4.000     46.236     0.000      4.000
```

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    45.236    0.000    4.000
    47.236   -1.995    3.465   46.236   -1.995    3.465
    45.236   -1.995    3.465
    47.236   -3.463    2.007   46.236   -3.300    2.165
    45.236   -3.138    2.324
$POINTS NETWORK = ZCANAFT2
1.0
1.0         0.         0.         0.         1.
      13.0      2.0
    53.318    0.000    4.000   53.318    1.995    3.465
    53.318    3.463    2.007   53.318    4.000   -0.001
    53.318    3.464   -2.008   53.318    2.007   -3.464
    53.318    0.000   -4.000   53.318   -2.007   -3.464
    53.318   -3.463   -2.007   53.318   -4.000   -0.001
    53.318   -3.463    2.007   53.318   -1.995    3.465
    53.318    0.000    4.000
    47.236    0.000    4.000   47.236    1.995    3.465
    47.236    3.463    2.007   47.236    4.000    0.000
    47.236    3.464   -2.007   47.236    2.007   -3.464
    47.236    0.000   -4.000   47.236   -2.007   -3.464
    47.236   -3.463   -2.007   47.236   -4.000    0.000
    47.236   -3.463    2.007   47.236   -1.995    3.465
    47.236    0.000    4.000
$POINTS NETWORK =    ZBOD2
1.0
1.0
       4.0     13.0
   132.459   -3.616    6.281   71.254   -3.616    6.281
    61.785   -3.167    5.500   53.318   -1.995    3.465
   132.459    0.000    7.250   71.254    0.000    7.250
    61.785    0.000    6.349   53.318    0.000    4.000
   132.459    3.616    6.281   71.254    3.616    6.281
    61.785    3.166    5.499   53.318    1.995    3.465
   132.459    6.278    3.638   71.254    6.278    3.638
    61.785    5.497    3.186   53.318    3.463    2.007
   132.459    7.251    0.000   71.254    7.250    0.000
    61.785    6.349    0.000   53.318    4.000   -0.001
   132.459    6.279   -3.638   71.254    6.278   -3.638
    61.785    5.498   -3.186   53.318    3.464   -2.008
   132.459    3.639   -6.278   71.254    3.638   -6.279
    61.785    3.186   -5.498   53.318    2.007   -3.464
   132.459    0.001   -7.251   71.254    0.000   -7.250
    61.785    0.001   -6.349   53.318    0.000   -4.000
   132.459   -3.638   -6.279   71.254   -3.638   -6.279
    61.785   -3.185   -5.498   53.318   -2.007   -3.464
   132.459   -6.278   -3.639   71.254   -6.278   -3.638
    61.785   -5.497   -3.186   53.318   -3.463   -2.007
   132.459   -7.250   -0.001   71.254   -7.250    0.000
    61.785   -6.349   -0.001   53.318   -4.000   -0.001
   132.459   -6.278    3.638   71.254   -6.278    3.638
    61.785   -5.497    3.185   53.318   -3.463    2.007
   132.459   -3.616    6.281   71.254   -3.616    6.281
    61.785   -3.167    5.500   53.318   -1.995    3.465
$POINTS NETWORK =    ZBODA4
1.0
1.0
       4.0     11.0
```

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```
    132.459    -6.278    -3.639   132.459    -7.250    -0.000
    132.459    -6.278     3.638   132.459    -3.616     6.281
    134.175    -6.549    -3.796   134.175    -7.564    -0.000
    134.175    -6.549     3.795   134.175    -3.773     6.552
    135.865    -6.816    -3.951   135.865    -7.872     0.000
    135.865    -6.817     3.950   135.865    -3.927     6.820
    137.500    -7.075    -4.100   137.500    -8.171     0.000
    137.500    -7.075     4.100   137.500    -4.076     7.078
    138.947    -7.239    -4.196   138.947    -8.361     0.000
    138.947    -7.240     4.195   138.947    -4.170     7.243
    140.100    -7.341    -4.254   140.100    -8.479     0.000
    140.100    -7.341     4.254   140.100    -4.229     7.344
    141.551    -7.469    -4.328   141.551    -8.626     0.000
    141.551    -7.469     4.328   141.551    -4.302     7.472
    143.975    -7.420    -4.300   143.975    -8.569     0.000
    143.975    -7.420     4.299   143.975    -4.274     7.423
    148.235    -6.650    -3.854   148.235    -7.680     0.000
    148.235    -6.649     3.853   148.235    -3.830     6.652
    153.934    -5.619    -3.257   153.934    -6.489     0.000
    153.934    -5.619     3.256   153.934    -3.237     5.621
    160.353    -4.457    -2.584   160.353    -5.148    -0.000
    160.353    -4.457     2.583   160.353    -2.568     4.459
$POINTS NETWORK =    ZBODA3
1.0
1.0
        4.0      11.0
    132.459     3.639    -6.278   132.459     0.000    -7.251
    132.459    -3.638    -6.279   132.459    -6.278    -3.639
    134.175     3.796    -6.550   134.175     0.000    -7.564
    134.175    -3.795    -6.550   134.175    -6.549    -3.796
    135.865     3.951    -6.817   135.865     0.000    -7.873
    135.865    -3.950    -6.817   135.865    -6.816    -3.951
    137.500     4.100    -7.076   137.500     0.000    -8.172
    137.500    -4.100    -7.076   137.500    -7.075    -4.100
    138.947     4.195    -7.240   138.947     0.000    -8.361
    138.947    -4.195    -7.240   138.947    -7.239    -4.196
    140.100     4.254    -7.341   140.100     0.000    -8.479
    140.100    -4.254    -7.341   140.100    -7.341    -4.254
    141.551     4.328    -7.469   141.551     0.000    -8.626
    141.551    -4.328    -7.469   141.551    -7.469    -4.328
    143.975     4.300    -7.420   143.975     0.000    -8.569
    143.975    -4.300    -7.420   143.975    -7.420    -4.300
    148.235     3.853    -6.650   148.235     0.000    -7.680
    148.235    -3.853    -6.650   148.235    -6.650    -3.854
    153.934     3.256    -5.619   153.934     0.000    -6.489
    153.934    -3.256    -5.619   153.934    -5.619    -3.257
    160.353     2.584    -4.458   160.353     0.000    -5.148
    160.353    -2.583    -4.458   160.353    -4.457    -2.584
$POINTS NETWORK =    ZBODA2
1.0
1.0
        4.0      11.0
    132.459     6.278     3.638   132.459     7.251     0.000
    132.459     6.279    -3.638   132.459     3.639    -6.278
    134.175     6.550     3.795   134.175     7.564     0.000
    134.175     6.550    -3.796   134.175     3.796    -6.550
    135.865     6.817     3.950   135.865     7.873     0.000
```

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    135.865     6.817    -3.950  135.865     3.951    -6.817
    137.500     7.075     4.100  137.500     8.172     0.000
    137.500     7.075    -4.100  137.500     4.100    -7.076
    138.947     7.240     4.195  138.947     8.361     0.000
    138.947     7.239    -4.196  138.947     4.195    -7.240
    140.100     7.341     4.254  140.100     8.479     0.000
    140.100     7.341    -4.254  140.100     4.254    -7.341
    141.551     7.469     4.328  141.551     8.626     0.000
    141.551     7.469    -4.328  141.551     4.328    -7.469
    143.975     7.420     4.300  143.975     8.569     0.000
    143.975     7.420    -4.300  143.975     4.300    -7.420
    148.235     6.649     3.853  148.235     7.680     0.000
    148.235     6.649    -3.853  148.235     3.853    -6.650
    153.934     5.618     3.256  153.934     6.489     0.000
    153.934     5.619    -3.256  153.934     3.256    -5.619
    160.353     4.457     2.583  160.353     5.148     0.000
    160.353     4.457    -2.583  160.353     2.584    -4.458
$POINTS NETWORK =     ZFIN2
1.0
2.0
       11.0       7.0
    132.459     6.278     3.638  134.176     6.550     3.795
    135.865     6.817     3.950  137.500     7.075     4.100
    138.948     7.240     4.195  140.101     7.341     4.254
    141.551     7.469     4.328  143.975     7.420     4.300
    148.235     6.649     3.853  153.934     5.618     3.256
    160.353     4.457     2.583
    132.480     7.119     4.856  133.996     7.408     5.052
    135.495     7.695     5.246  136.960     7.975     5.436
    138.272     8.147     5.552  139.314     8.249     5.619
    140.676     8.382     5.708  143.055     8.379     5.718
    147.477     7.746     5.351  153.507     6.882     4.850
    160.341     5.903     4.283
    132.502     7.960     6.074  133.818     8.267     6.307
    135.128     8.572     6.540  136.422     8.874     6.770
    137.598     9.055     6.907  138.530     9.156     6.983
    139.801     9.294     7.086  142.132     9.335     7.134
    146.713     8.835     6.844  153.075     8.140     6.441
    160.328     7.348     5.983
    132.523     8.801     7.291  133.642     9.125     7.562
    134.763     9.448     7.833  135.885     9.773     8.104
    136.926     9.962     8.261  137.749    10.062     8.344
    138.929    10.205     8.462  141.207    10.288     8.548
    145.945     9.917     8.333  152.641     9.394     8.030
    160.316     8.794     7.682
    132.544     9.642     8.508  133.469     9.982     8.815
    134.402    10.324     9.123  135.350    10.671     9.437
    136.255    10.869     9.615  136.970    10.966     9.702
    138.059    11.115     9.835  140.281    11.238     9.960
    145.175    10.994     9.819  152.205    10.643     9.616
    160.303    10.239     9.382
    132.566    10.484     9.726  133.301    10.838    10.066
    134.047    11.198    10.413  134.817    11.569    10.770
    135.587    11.775    10.968  136.195    11.869    11.058
    137.190    12.023    11.206  139.354    12.185    11.371
    144.403    12.065    11.301  151.768    11.888    11.199
    160.291    11.685    11.081
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  132.587   11.325   10.943  133.137   11.695   11.318
  133.701   12.073   11.702  134.288   12.467   12.102
  134.924   12.681   12.320  135.424   12.769   12.410
  136.323   12.929   12.574  138.428   13.131   12.781
  143.632   13.131   12.781  151.331   13.130   12.781
  160.278   13.130   12.781
$POINTS NETWORK =    ZFIN4
1.0
2.0
     11.0      7.0
  132.459   -6.278   -3.639  134.175   -6.549   -3.796
  135.865   -6.816   -3.951  137.500   -7.075   -4.100
  138.947   -7.239   -4.196  140.100   -7.341   -4.254
  141.551   -7.469   -4.328  143.975   -7.420   -4.300
  148.235   -6.650   -3.854  153.934   -5.619   -3.257
  160.353   -4.457   -2.584
  132.480   -7.119   -4.856  133.996   -7.408   -5.052
  135.495   -7.695   -5.246  136.960   -7.975   -5.436
  138.272   -8.147   -5.552  139.314   -8.249   -5.619
  140.676   -8.382   -5.708  143.055   -8.379   -5.718
  147.477   -7.746   -5.351  153.507   -6.882   -4.850
  160.341   -5.903   -4.283
  132.502   -7.960   -6.074  133.818   -8.267   -6.307
  135.128   -8.572   -6.540  136.422   -8.874   -6.770
  137.598   -9.055   -6.907  138.530   -9.156   -6.983
  139.801   -9.294   -7.086  142.132   -9.335   -7.134
  146.713   -8.835   -6.844  153.075   -8.140   -6.441
  160.328   -7.348   -5.983
  132.523   -8.801   -7.291  133.642   -9.125   -7.562
  134.763   -9.448   -7.833  135.885   -9.773   -8.104
  136.926   -9.962   -8.261  137.749  -10.062   -8.344
  138.929  -10.205   -8.462  141.207  -10.288   -8.548
  145.945   -9.917   -8.333  152.641   -9.394   -8.030
  160.316   -8.794   -7.682
  132.544   -9.642   -8.508  133.469   -9.982   -8.815
  134.402  -10.324   -9.123  135.350  -10.671   -9.437
  136.255  -10.869   -9.615  136.970  -10.966   -9.702
  138.059  -11.115   -9.835  140.281  -11.238   -9.960
  145.175  -10.994   -9.819  152.205  -10.643   -9.616
  160.303  -10.239   -9.382
  132.566  -10.484   -9.726  133.301  -10.838  -10.066
  134.047  -11.198  -10.413  134.817  -11.569  -10.770
  135.587  -11.775  -10.968  136.195  -11.869  -11.058
  137.190  -12.023  -11.206  139.354  -12.185  -11.371
  144.403  -12.065  -11.301  151.768  -11.888  -11.199
  160.291  -11.685  -11.081
  132.587  -11.325  -10.943  133.137  -11.695  -11.318
  133.701  -12.073  -11.702  134.288  -12.467  -12.102
  134.924  -12.681  -12.320  135.424  -12.769  -12.410
  136.323  -12.929  -12.574  138.428  -13.131  -12.781
  143.632  -13.131  -12.781  151.331  -13.130  -12.781
  160.278  -13.130  -12.781
$POINTS NETWORK =    ZFIN3
1.0
2.0
     11.0      7.0
  132.459    3.639   -6.278  134.175    3.796   -6.550
```

135.865	3.951	-6.817	137.500	4.100	-7.076
138.947	4.195	-7.240	140.100	4.254	-7.341
141.551	4.328	-7.469	143.975	4.300	-7.420
148.235	3.853	-6.650	153.934	3.256	-5.619
160.353	2.584	-4.458			
132.480	4.856	-7.119	133.996	5.052	-7.408
135.495	5.246	-7.695	136.960	5.436	-7.975
138.272	5.552	-8.147	139.314	5.619	-8.249
140.676	5.708	-8.382	143.055	5.718	-8.379
147.477	5.351	-7.746	153.507	4.850	-6.882
160.341	4.283	-5.903			
132.502	6.074	-7.960	133.818	6.307	-8.267
135.128	6.540	-8.572	136.422	6.770	-8.874
137.598	6.907	-9.055	138.530	6.983	-9.156
139.801	7.086	-9.294	142.132	7.134	-9.335
146.713	6.844	-8.835	153.075	6.441	-8.140
160.328	5.983	-7.348			
132.523	7.291	-8.801	133.642	7.562	-9.125
134.763	7.833	-9.448	135.885	8.104	-9.773
136.926	8.261	-9.962	137.749	8.344	-10.062
138.929	8.462	-10.205	141.207	8.548	-10.288
145.945	8.333	-9.917	152.641	8.030	-9.394
160.316	7.682	-8.794			
132.544	8.508	-9.642	133.469	8.815	-9.982
134.402	9.123	-10.324	135.350	9.437	-10.671
136.255	9.615	-10.869	136.970	9.702	-10.966
138.059	9.835	-11.115	140.281	9.960	-11.238
145.175	9.819	-10.994	152.205	9.616	-10.643
160.303	9.382	-10.239			
132.566	9.726	-10.484	133.301	10.066	-10.838
134.047	10.413	-11.198	134.817	10.770	-11.569
135.587	10.968	-11.775	136.195	11.058	-11.869
137.190	11.206	-12.023	139.354	11.371	-12.185
144.403	11.301	-12.065	151.768	11.199	-11.888
160.291	11.081	-11.685			
132.587	10.943	-11.325	133.137	11.318	-11.695
133.701	11.702	-12.073	134.288	12.102	-12.467
134.924	12.320	-12.681	135.424	12.410	-12.769
136.323	12.574	-12.929	138.428	12.781	-13.131
143.632	12.781	-13.131	151.331	12.781	-13.130
160.278	12.781	-13.130			

$POINTS NETWORK = ZBODA1
1.0
1.0

4.0	11.0				
132.459	-3.616	6.281	132.459	0.000	7.250
132.459	3.616	6.281	132.459	6.278	3.638
134.175	-3.773	6.552	134.175	0.000	7.563
134.175	3.773	6.552	134.175	6.550	3.795
135.865	-3.927	6.820	135.865	0.000	7.872
135.865	3.927	6.820	135.865	6.817	3.950
137.500	-4.076	7.078	137.500	0.000	8.170
137.500	4.076	7.078	137.500	7.075	4.100
138.947	-4.170	7.243	138.947	0.000	8.360
138.947	4.170	7.243	138.947	7.240	4.195
140.100	-4.229	7.344	140.100	0.000	8.477
140.100	4.229	7.344	140.100	7.341	4.254

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141.551  -4.302   7.472  141.551   0.000   8.625
141.551   4.302   7.472  141.551   7.469   4.328
143.975  -4.274   7.423  143.975   0.000   8.568
143.975   4.274   7.423  143.975   7.420   4.300
148.235  -3.830   6.652  148.235   0.000   7.679
148.235   3.830   6.652  148.235   6.649   3.853
153.934  -3.237   5.621  153.934   0.000   6.488
153.934   3.236   5.621  153.934   5.618   3.256
160.353  -2.568   4.459  160.353   0.000   5.147
160.353   2.568   4.460  160.353   4.457   2.583
$POINTS NETWORK =     ZFIN1
1.0
2.0
   11.0      7.0
132.459  -3.616   6.281  134.176  -3.773   6.552
135.865  -3.927   6.820  137.500  -4.076   7.078
138.948  -4.170   7.243  140.101  -4.229   7.344
141.551  -4.302   7.472  143.975  -4.274   7.423
148.235  -3.830   6.652  153.934  -3.237   5.621
160.353  -2.568   4.459
132.480  -4.856   7.119  133.996  -5.052   7.408
135.495  -5.246   7.695  136.960  -5.436   7.975
138.272  -5.552   8.147  139.314  -5.619   8.249
140.676  -5.708   8.382  143.055  -5.718   8.379
147.477  -5.351   7.746  153.507  -4.850   6.882
160.341  -4.283   5.903
132.502  -6.074   7.960  133.818  -6.307   8.267
135.128  -6.540   8.572  136.422  -6.770   8.874
137.598  -6.907   9.055  138.530  -6.983   9.156
139.801  -7.086   9.294  142.132  -7.134   9.335
146.713  -6.844   8.835  153.075  -6.441   8.140
160.328  -5.983   7.348
132.523  -7.291   8.801  133.642  -7.562   9.125
134.763  -7.833   9.448  135.885  -8.104   9.773
136.926  -8.261   9.962  137.749  -8.344  10.062
138.929  -8.462  10.205  141.207  -8.548  10.288
145.945  -8.333   9.917  152.641  -8.030   9.394
160.316  -7.682   8.794
132.544  -8.508   9.642  133.469  -8.815   9.982
134.402  -9.123  10.324  135.350  -9.437  10.671
136.255  -9.615  10.869  136.970  -9.702  10.966
138.059  -9.835  11.115  140.281  -9.960  11.238
145.175  -9.819  10.994  152.205  -9.616  10.643
160.303  -9.382  10.239
132.566  -9.726  10.484  133.301 -10.066  10.838
134.047 -10.413  11.198  134.817 -10.770  11.569
135.587 -10.968  11.775  136.195 -11.058  11.869
137.190 -11.206  12.023  139.354 -11.371  12.185
144.403 -11.301  12.065  151.768 -11.199  11.888
160.291 -11.081  11.685
132.587 -10.943  11.325  133.137 -11.318  11.695
133.701 -11.702  12.073  134.288 -12.102  12.467
134.924 -12.320  12.681  135.424 -12.410  12.769
136.323 -12.574  12.929  138.428 -12.781  13.131
143.632 -12.781  13.131  151.331 -12.781  13.130
160.278 -12.781  13.130
$POINTS NETWORK =     ZEND
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1.0
5.0       0.        0.        0.        0.
     13.0       2.0
   160.353    -2.568     4.459   160.353     0.000     5.148
   160.353     2.568     4.460   160.353     4.457     2.583
   160.353     5.148     0.000   160.353     4.457    -2.583
   160.353     2.584    -4.458   160.353     0.000    -5.148
   160.353    -2.583    -4.458   160.353    -4.457    -2.584
   160.353    -5.148    -0.001   160.353    -4.457     2.583
   160.353    -2.568     4.459
   160.350     0.000     0.000   160.350     0.000     0.000
   160.350     0.000     0.000   160.350     0.000     0.000
   160.350     0.000     0.000   160.350     0.000     0.000
   160.350     0.000     0.000   160.350     0.000     0.000
   160.350     0.000     0.000   160.350     0.000     0.000
   160.350     0.000     0.000   160.350     0.000     0.000
   160.350     0.000     0.000
$POINTS NETWORK = ZFINWAK2
1.0
18.0      0.        0.        0.        1.
      7.0       2.0
   160.353     4.457     2.583   160.341     5.903     4.283
   160.328     7.348     5.983   160.316     8.794     7.682
   160.303    10.239     9.382   160.291    11.685    11.081
   160.278    13.130    12.781
  1160.353     4.457     2.583  1160.341     5.903     4.283
  1160.328     7.348     5.983  1160.316     8.794     7.682
  1160.303    10.239     9.382  1160.291    11.685    11.081
  1160.278    13.130    12.781
$POINTS NETWORK = ZFINWAK1
1.0
18.0      0.        0.        0.        1.
      7.0       2.0
   160.353    -2.568     4.459   160.341    -4.283     5.903
   160.328    -5.983     7.348   160.316    -7.682     8.794
   160.303    -9.382    10.239   160.291   -11.081    11.685
   160.278   -12.781    13.130
  1160.353    -2.568     4.459  1160.341    -4.283     5.903
  1160.328    -5.983     7.348  1160.316    -7.682     8.794
  1160.303    -9.382    10.239  1160.291   -11.081    11.685
  1160.278   -12.781    13.130
$POINTS NETWORK = ZFINWAK4
1.0
18.0      0.        0.        0.        1.
      7.0       2.0
   160.353    -4.457    -2.584   160.341    -5.903    -4.283
   160.328    -7.348    -5.983   160.316    -8.794    -7.682
   160.303   -10.239    -9.382   160.291   -11.685   -11.081
   160.278   -13.130   -12.781
  1160.353    -4.457    -2.584  1160.341    -5.903    -4.283
  1160.328    -7.348    -5.983  1160.316    -8.794    -7.682
  1160.303   -10.239    -9.382  1160.291   -11.685   -11.081
  1160.278   -13.130   -12.781
$POINTS NETWORK = ZFINWAK3
1.0
18.0      0.        0.        0.        1.
      7.0       2.0
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    160.353     2.584    -4.458   160.341     4.283    -5.903
    160.328     5.983    -7.348   160.316     7.682    -8.794
    160.303     9.382   -10.239   160.291    11.081   -11.685
    160.278    12.781   -13.130
   1160.353     2.584    -4.458  1160.341     4.283    -5.903
   1160.328     5.983    -7.348  1160.316     7.682    -8.794
   1160.303     9.382   -10.239  1160.291    11.081   -11.685
   1160.278    12.781   -13.130
$POINTS NETWORK = ZCNBDWK1
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       9.0      16.0
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     45.130    -6.146     4.841    45.077    -7.650     6.100
     45.025    -9.155     7.358    44.972   -10.659     8.616
     44.919   -12.163     9.875    44.866   -13.668    11.133
     44.813   -15.172    12.392
     53.318    -3.463     2.007    53.265    -4.967     3.265
     53.212    -6.471     4.523    53.160    -7.976     5.782
     53.107    -9.480     7.040    53.054   -10.984     8.299
     53.001   -12.489     9.557    52.948   -13.993    10.816
     52.896   -15.497    12.074
     61.785    -5.497     3.185    61.732    -7.001     4.444
     61.679    -8.505     5.702    61.627   -10.010     6.960
     61.574   -11.514     8.219    61.521   -13.018     9.477
     61.468   -14.523    10.736    61.415   -16.027    11.994
     61.362   -17.531    13.253
     71.254    -6.278     3.638    71.201    -7.782     4.896
     71.148    -9.286     6.155    71.096   -10.790     7.413
     71.043   -12.295     8.672    70.990   -13.799     9.930
     70.937   -15.303    11.189    70.884   -16.808    12.447
     70.831   -18.312    13.705
    132.459    -6.278     3.638   132.406    -7.782     4.896
    132.353    -9.286     6.155   132.301   -10.791     7.413
    132.248   -12.295     8.672   132.195   -13.799     9.930
    132.142   -15.304    11.189   132.089   -16.808    12.447
    132.036   -18.312    13.705
    134.175    -6.549     3.795   134.122    -8.054     5.054
    134.070    -9.558     6.312   134.017   -11.062     7.570
    133.964   -12.566     8.829   133.911   -14.071    10.087
    133.858   -15.575    11.346   133.806   -17.079    12.604
    133.753   -18.583    13.863
    135.865    -6.817     3.950   135.812    -8.321     5.208
    135.759    -9.825     6.467   135.706   -11.329     7.725
    135.653   -12.834     8.984   135.600   -14.338    10.242
    135.548   -15.842    11.501   135.495   -17.347    12.759
    135.442   -18.851    14.018
    137.500    -7.075     4.100   137.447    -8.580     5.358
    137.394   -10.084     6.617   137.341   -11.588     7.875
    137.288   -13.092     9.134   137.236   -14.597    10.392
    137.183   -16.101    11.651   137.130   -17.605    12.909
    137.077   -19.109    14.168
    138.947    -7.240     4.195   138.895    -8.744     5.454
    138.842   -10.248     6.712   138.789   -11.752     7.971
    138.736   -13.257     9.229   138.683   -14.761    10.488
    138.631   -16.265    11.746   138.578   -17.770    13.004
    138.525   -19.274    14.263
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  140.100    -7.341     4.254  140.048    -8.845     5.512
  139.995   -10.350     6.771  139.942   -11.854     8.029
  139.889   -13.358     9.288  139.836   -14.863    10.546
  139.784   -16.367    11.805  139.731   -17.871    13.063
  139.678   -19.375    14.322
  141.551    -7.469     4.328  141.498    -8.973     5.586
  141.445   -10.477     6.845  141.393   -11.981     8.103
  141.340   -13.486     9.362  141.287   -14.990    10.620
  141.234   -16.494    11.879  141.181   -17.999    13.137
  141.129   -19.503    14.396
  143.975    -7.420     4.299  143.923    -8.924     5.558
  143.870   -10.428     6.816  143.817   -11.933     8.075
  143.764   -13.437     9.333  143.711   -14.941    10.592
  143.658   -16.445    11.850  143.606   -17.950    13.109
  143.553   -19.454    14.367
  148.235    -6.649     3.853  148.182    -8.154     5.111
  148.129    -9.658     6.370  148.076   -11.162     7.628
  148.023   -12.667     8.887  147.971   -14.171    10.145
  147.918   -15.675    11.404  147.865   -17.179    12.662
  147.812   -18.684    13.921
  153.934    -5.619     3.256  153.881    -7.123     4.514
  153.828    -8.627     5.773  153.776   -10.131     7.031
  153.723   -11.636     8.290  153.670   -13.140     9.548
  153.617   -14.644    10.806  153.564   -16.149    12.065
  153.512   -17.653    13.323
  160.353    -4.457     2.583  160.301    -5.962     3.841
  160.248    -7.466     5.100  160.195    -8.970     6.358
  160.142   -10.475     7.617  160.089   -11.979     8.875
  160.036   -13.483    10.134  159.984   -14.987    11.392
  159.931   -16.492    12.651
 1160.353    -4.457     2.583 1160.301    -5.962     3.841
 1160.248    -7.466     5.100 1160.195    -8.970     6.358
 1160.142   -10.475     7.617 1160.089   -11.979     8.875
 1160.036   -13.483    10.134 1159.984   -14.987    11.392
 1159.931   -16.492    12.651
$POINTS NETWORK = ZCNBDWK2
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       9.0      16.0
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    45.130    -4.841    -6.146    45.077    -6.100    -7.650
    45.025    -7.358    -9.155    44.972    -8.616   -10.659
    44.919    -9.875   -12.163    44.866   -11.133   -13.668
    44.813   -12.392   -15.172
    53.318    -2.007    -3.463    53.265    -3.265    -4.967
    53.212    -4.523    -6.471    53.160    -5.782    -7.976
    53.107    -7.040    -9.480    53.054    -8.299   -10.984
    53.001    -9.557   -12.489    52.948   -10.816   -13.993
    52.896   -12.074   -15.497
    61.785    -3.185    -5.497    61.732    -4.444    -7.001
    61.679    -5.702    -8.505    61.627    -6.960   -10.010
    61.574    -8.219   -11.514    61.521    -9.477   -13.018
    61.468   -10.736   -14.523    61.415   -11.994   -16.027
    61.362   -13.253   -17.531
    71.254    -3.638    -6.278    71.201    -4.896    -7.782
    71.148    -6.155    -9.286    71.096    -7.413   -10.790
    71.043    -8.672   -12.295    70.990    -9.930   -13.799
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872	70.937	-11.189	-15.303	70.884	-12.447	-16.808
873	70.831	-13.705	-18.312			
874	132.459	-3.638	-6.278	132.406	-4.896	-7.782
875	132.353	-6.155	-9.286	132.301	-7.413	-10.791
876	132.248	-8.672	-12.295	132.195	-9.930	-13.799
877	132.142	-11.189	-15.304	132.089	-12.447	-16.808
878	132.036	-13.705	-18.312			
879	134.175	-3.795	-6.549	134.122	-5.054	-8.054
880	134.070	-6.312	-9.558	134.017	-7.570	-11.062
881	133.964	-8.829	-12.566	133.911	-10.087	-14.071
882	133.858	-11.346	-15.575	133.806	-12.604	-17.079
883	133.753	-13.863	-18.583			
884	135.865	-3.950	-6.817	135.812	-5.208	-8.321
885	135.759	-6.467	-9.825	135.706	-7.725	-11.329
886	135.653	-8.984	-12.834	135.600	-10.242	-14.338
887	135.548	-11.501	-15.842	135.495	-12.759	-17.347
888	135.442	-14.018	-18.851			
889	137.500	-4.100	-7.075	137.447	-5.358	-8.580
890	137.394	-6.617	-10.084	137.341	-7.875	-11.588
891	137.288	-9.134	-13.092	137.236	-10.392	-14.597
892	137.183	-11.651	-16.101	137.130	-12.909	-17.605
893	137.077	-14.168	-19.109			
894	138.947	-4.195	-7.240	138.895	-5.454	-8.744
895	138.842	-6.712	-10.248	138.789	-7.971	-11.752
896	138.736	-9.229	-13.257	138.683	-10.488	-14.761
897	138.631	-11.746	-16.265	138.578	-13.004	-17.770
898	138.525	-14.263	-19.274			
899	140.100	-4.254	-7.341	140.048	-5.512	-8.845
900	139.995	-6.771	-10.350	139.942	-8.029	-11.854
901	139.889	-9.288	-13.358	139.836	-10.546	-14.863
902	139.784	-11.805	-16.367	139.731	-13.063	-17.871
903	139.678	-14.322	-19.375			
904	141.551	-4.328	-7.469	141.498	-5.586	-8.973
905	141.445	-6.845	-10.477	141.393	-8.103	-11.981
906	141.340	-9.362	-13.486	141.287	-10.620	-14.990
907	141.234	-11.879	-16.494	141.181	-13.137	-17.999
908	141.129	-14.396	-19.503			
909	143.975	-4.299	-7.420	143.923	-5.558	-8.924
910	143.870	-6.816	-10.428	143.817	-8.075	-11.933
911	143.764	-9.333	-13.437	143.711	-10.592	-14.941
912	143.658	-11.850	-16.445	143.606	-13.109	-17.950
913	143.553	-14.367	-19.454			
914	148.235	-3.853	-6.649	148.182	-5.111	-8.154
915	148.129	-6.370	-9.658	148.076	-7.628	-11.162
916	148.023	-8.887	-12.667	147.971	-10.145	-14.171
917	147.918	-11.404	-15.675	147.865	-12.662	-17.179
918	147.812	-13.921	-18.684			
919	153.934	-3.256	-5.619	153.881	-4.514	-7.123
920	153.828	-5.773	-8.627	153.776	-7.031	-10.131
921	153.723	-8.290	-11.636	153.670	-9.548	-13.140
922	153.617	-10.806	-14.644	153.564	-12.065	-16.149
923	153.512	-13.323	-17.653			
924	160.353	-2.583	-4.457	160.301	-3.841	-5.962
925	160.248	-5.100	-7.466	160.195	-6.358	-8.970
926	160.142	-7.617	-10.475	160.089	-8.875	-11.979
927	160.036	-10.134	-13.483	159.984	-11.392	-14.987
928	159.931	-12.651	-16.492			

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  1160.353    -2.583    -4.457  1160.301    -3.841    -5.962
  1160.248    -5.100    -7.466  1160.195    -6.358    -8.970
  1160.142    -7.617   -10.475  1160.089    -8.875   -11.979
  1160.036   -10.134   -13.483  1159.984   -11.392   -14.987
  1159.931   -12.651   -16.492
$POINTS NETWORK = ZCNBDWK3
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    45.130     6.146    -4.841    45.077     7.650    -6.100
    45.025     9.155    -7.358    44.972    10.659    -8.616
    44.919    12.163    -9.875    44.866    13.668   -11.133
    44.813    15.172   -12.392
    53.318     3.463    -2.007    53.265     4.967    -3.265
    53.212     6.471    -4.523    53.160     7.976    -5.782
    53.107     9.480    -7.040    53.054    10.984    -8.299
    53.001    12.489    -9.557    52.948    13.993   -10.816
    52.896    15.497   -12.074
    61.785     5.497    -3.185    61.732     7.001    -4.444
    61.679     8.505    -5.702    61.627    10.010    -6.960
    61.574    11.514    -8.219    61.521    13.018    -9.477
    61.468    14.523   -10.736    61.415    16.027   -11.994
    61.362    17.531   -13.253
    71.254     6.278    -3.638    71.201     7.782    -4.896
    71.148     9.286    -6.155    71.096    10.790    -7.413
    71.043    12.295    -8.672    70.990    13.799    -9.930
    70.937    15.303   -11.189    70.884    16.808   -12.447
    70.831    18.312   -13.705
   132.459     6.278    -3.638   132.406     7.782    -4.896
   132.353     9.286    -6.155   132.301    10.791    -7.413
   132.248    12.295    -8.672   132.195    13.799    -9.930
   132.142    15.304   -11.189   132.089    16.808   -12.447
   132.036    18.312   -13.705
   134.175     6.549    -3.795   134.122     8.054    -5.054
   134.070     9.558    -6.312   134.017    11.062    -7.570
   133.964    12.566    -8.829   133.911    14.071   -10.087
   133.858    15.575   -11.346   133.806    17.079   -12.604
   133.753    18.583   -13.863
   135.865     6.817    -3.950   135.812     8.321    -5.208
   135.759     9.825    -6.467   135.706    11.329    -7.725
   135.653    12.834    -8.984   135.600    14.338   -10.242
   135.548    15.842   -11.501   135.495    17.347   -12.759
   135.442    18.851   -14.018
   137.500     7.075    -4.100   137.447     8.580    -5.358
   137.394    10.084    -6.617   137.341    11.588    -7.875
   137.288    13.092    -9.134   137.236    14.597   -10.392
   137.183    16.101   -11.651   137.130    17.605   -12.909
   137.077    19.109   -14.168
   138.947     7.240    -4.195   138.895     8.744    -5.454
   138.842    10.248    -6.712   138.789    11.752    -7.971
   138.736    13.257    -9.229   138.683    14.761   -10.488
   138.631    16.265   -11.746   138.578    17.770   -13.004
   138.525    19.274   -14.263
   140.100     7.341    -4.254   140.048     8.845    -5.512
   139.995    10.350    -6.771   139.942    11.854    -8.029
   139.889    13.358    -9.288   139.836    14.863   -10.546
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 141.551    7.469   -4.328   141.498    8.973   -5.586
 141.445   10.477   -6.845   141.393   11.981   -8.103
 141.340   13.486   -9.362   141.287   14.990  -10.620
 141.234   16.494  -11.879   141.181   17.999  -13.137
 141.129   19.503  -14.396
 143.975    7.420   -4.299   143.923    8.924   -5.558
 143.870   10.428   -6.816   143.817   11.933   -8.075
 143.764   13.437   -9.333   143.711   14.941  -10.592
 143.658   16.445  -11.850   143.606   17.950  -13.109
 143.553   19.454  -14.367
 148.235    6.649   -3.853   148.182    8.154   -5.111
 148.129    9.658   -6.370   148.076   11.162   -7.628
 148.023   12.667   -8.887   147.971   14.171  -10.145
 147.918   15.675  -11.404   147.865   17.179  -12.662
 147.812   18.684  -13.921
 153.934    5.619   -3.256   153.881    7.123   -4.514
 153.828    8.627   -5.773   153.776   10.131   -7.031
 153.723   11.636   -8.290   153.670   13.140   -9.548
 153.617   14.644  -10.806   153.564   16.149  -12.065
 153.512   17.653  -13.323
 160.353    4.457   -2.583   160.301    5.962   -3.841
 160.248    7.466   -5.100   160.195    8.970   -6.358
 160.142   10.475   -7.617   160.089   11.979   -8.875
 160.036   13.483  -10.134   159.984   14.987  -11.392
 159.931   16.492  -12.651
1160.353    4.457   -2.583  1160.301    5.962   -3.841
1160.248    7.466   -5.100  1160.195    8.970   -6.358
1160.142   10.475   -7.617  1160.089   11.979   -8.875
1160.036   13.483  -10.134  1159.984   14.987  -11.392
1159.931   16.492  -12.651
$POINTS NETWORK = ZCNBDWK4
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     9.0     16.0
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  45.130    4.841    6.146    45.077    6.100    7.650
  45.025    7.358    9.155    44.972    8.616   10.659
  44.919    9.875   12.163    44.866   11.133   13.668
  44.813   12.392   15.172
  53.318    2.007    3.463    53.265    3.265    4.967
  53.212    4.523    6.471    53.160    5.782    7.976
  53.107    7.040    9.480    53.054    8.299   10.984
  53.001    9.557   12.489    52.948   10.816   13.993
  52.896   12.074   15.497
  61.785    3.185    5.497    61.732    4.444    7.001
  61.679    5.702    8.505    61.627    6.960   10.010
  61.574    8.219   11.514    61.521    9.477   13.018
  61.468   10.736   14.523    61.415   11.994   16.027
  61.362   13.253   17.531
  71.254    3.638    6.278    71.201    4.896    7.782
  71.148    6.155    9.286    71.096    7.413   10.790
  71.043    8.672   12.295    70.990    9.930   13.799
  70.937   11.189   15.303    70.884   12.447   16.808
  70.831   13.705   18.312
 132.459    3.638    6.278   132.406    4.896    7.782
```

1043	132.353	6.155	9.286	132.301	7.413	10.791
1044	132.248	8.672	12.295	132.195	9.930	13.799
1045	132.142	11.189	15.304	132.089	12.447	16.808
1046	132.036	13.705	18.312			
1047	134.175	3.795	6.549	134.122	5.054	8.054
1048	134.070	6.312	9.558	134.017	7.570	11.062
1049	133.964	8.829	12.566	133.911	10.087	14.071
1050	133.858	11.346	15.575	133.806	12.604	17.079
1051	133.753	13.863	18.583			
1052	135.865	3.950	6.817	135.812	5.208	8.321
1053	135.759	6.467	9.825	135.706	7.725	11.329
1054	135.653	8.984	12.834	135.600	10.242	14.338
1055	135.548	11.501	15.842	135.495	12.759	17.347
1056	135.442	14.018	18.851			
1057	137.500	4.100	7.075	137.447	5.358	8.580
1058	137.394	6.617	10.084	137.341	7.875	11.588
1059	137.288	9.134	13.092	137.236	10.392	14.597
1060	137.183	11.651	16.101	137.130	12.909	17.605
1061	137.077	14.168	19.109			
1062	138.947	4.195	7.240	138.895	5.454	8.744
1063	138.842	6.712	10.248	138.789	7.971	11.752
1064	138.736	9.229	13.257	138.683	10.488	14.761
1065	138.631	11.746	16.265	138.578	13.004	17.770
1066	138.525	14.263	19.274			
1067	140.100	4.254	7.341	140.048	5.512	8.845
1068	139.995	6.771	10.350	139.942	8.029	11.854
1069	139.889	9.288	13.358	139.836	10.546	14.863
1070	139.784	11.805	16.367	139.731	13.063	17.871
1071	139.678	14.322	19.375			
1072	141.551	4.328	7.469	141.498	5.586	8.973
1073	141.445	6.845	10.477	141.393	8.103	11.981
1074	141.340	9.362	13.486	141.287	10.620	14.990
1075	141.234	11.879	16.494	141.181	13.137	17.999
1076	141.129	14.396	19.503			
1077	143.975	4.299	7.420	143.923	5.558	8.924
1078	143.870	6.816	10.428	143.817	8.075	11.933
1079	143.764	9.333	13.437	143.711	10.592	14.941
1080	143.658	11.850	16.445	143.606	13.109	17.950
1081	143.553	14.367	19.454			
1082	148.235	3.853	6.649	148.182	5.111	8.154
1083	148.129	6.370	9.658	148.076	7.628	11.162
1084	148.023	8.887	12.667	147.971	10.145	14.171
1085	147.918	11.404	15.675	147.865	12.662	17.179
1086	147.812	13.921	18.684			
1087	153.934	3.256	5.619	153.881	4.514	7.123
1088	153.828	5.773	8.627	153.776	7.031	10.131
1089	153.723	8.290	11.636	153.670	9.548	13.140
1090	153.617	10.806	14.644	153.564	12.065	16.149
1091	153.512	13.323	17.653			
1092	160.353	2.583	4.457	160.301	3.841	5.962
1093	160.248	5.100	7.466	160.195	6.358	8.970
1094	160.142	7.617	10.475	160.089	8.875	11.979
1095	160.036	10.134	13.483	159.984	11.392	14.987
1096	159.931	12.651	16.492			
1097	1160.353	2.583	4.457	1160.301	3.841	5.962
1098	1160.248	5.100	7.466	1160.195	6.358	8.970
1099	1160.142	7.617	10.475	1160.089	8.875	11.979

```
  1100   1160.036    10.134    13.483  1159.984    11.392    14.987
  1101   1159.931    12.651    16.492
  1102 $POINTS NETWORK =  ZBODWAK
  1103 1.0
  1104 18.         1.                          1.
  1105       13.0        2.0
  1106    160.353    -2.568     4.459   160.353     0.000     5.148
  1107    160.353     2.568     4.460   160.353     4.457     2.583
  1108    160.353     5.148     0.000   160.353     4.457    -2.583
  1109    160.353     2.584    -4.458   160.353     0.000    -5.148
  1110    160.353    -2.583    -4.458   160.353    -4.457    -2.584
  1111    160.353    -5.148    -0.001   160.353    -4.457     2.583
  1112    160.353    -2.568     4.459
  1113   1160.353    -2.568     4.459  1160.353     0.000     5.148
  1114   1160.353     2.568     4.460  1160.353     4.457     2.583
  1115   1160.353     5.148     0.000  1160.353     4.457    -2.583
  1116   1160.353     2.584    -4.458  1160.353     0.000    -5.148
  1117   1160.353    -2.583    -4.458  1160.353    -4.457    -2.584
  1118   1160.353    -5.148    -0.001  1160.353    -4.457     2.583
  1119   1160.353    -2.568     4.459
  1120 $END
1

                         record of input processing


  $TIT
  $SYM
  $MAC
  $CAS
  $ANG
  $PRI
  $REF
  $POI
     kn,kt              1         2
    network # being processed   1    9.0000    9.0000    0.0000    0.0000    0.0000    0.0000

  $POI
     kn,kt              1         2
    network # being processed   2    9.0000    9.0000    0.0000    0.0000    0.0000    0.0000

  $POI
     kn,kt              1         2
    network # being processed   3    9.0000    9.0000    0.0000    0.0000    0.0000    0.0000

  $POI
     kn,kt              1         2
    network # being processed   4    9.0000    9.0000    0.0000    0.0000    0.0000    0.0000

  $POI
     kn,kt              1         1
    network # being processed   5    4.0000   13.0000    0.0000    0.0000    0.0000    0.0000

  $POI
     kn,kt              1         1
    network # being processed   6   13.0000    2.0000    0.0000    0.0000    0.0000    0.0000
```

APPENDIX B. GBU-24 OUPUT FILE (EDGE ANALYSIS)

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Mar 7 1996 13:51 **results** Page 58

abutment	nw-ident	ntd	knet.edge	nw-ident	ntd	knet.edge	
1		12	1.1-		18	30.1+	
		18	30.1-		12	1.1+	
2		12	1.2-		12	1.2+	probable error: unabutted free edge
3		12	1.3-		12	1.3+	probable error: unabutted free edge
4		12	10.2-		12	11.4-	
		12	11.4+		12	1.4+	
		12	1.4-		12	10.2+	
5		12	2.1-		18	29.1+	
		18	29.1-		12	2.1+	
6		12	2.2-		12	2.2+	probable error: unabutted free edge
7		12	2.3-		12	2.3+	probable error: unabutted free edge
8		12	9.2-		12	10.4-	
		12	10.4+		12	2.4+	
		12	2.4-		12	9.2+	
9		12	3.1-		18	31.1+	
		18	31.1-		12	3.1+	
10		12	3.2-		12	3.2+	probable error: unabutted free edge
11		12	3.3-		12	3.3+	probable error: unabutted free edge
12		12	11.2-		12	8.4-	
		12	8.4+		12	3.4+	
		12	3.4-		12	11.2+	
13		12	4.1-		18	28.1+	
		18	28.1-		12	4.1+	
14		12	4.2-		12	4.2+	probable error: unabutted free edge
15		12	4.3-		12	4.3+	probable error: unabutted free edge
16		12	8.2-		12	9.4-	
		12	9.4+		12	4.4+	
		12	4.4-		12	8.2+	
17		12	6.4+		12	5.1+	
		12	5.1-		12	6.4-	
18		12	5.4+		12	5.2+	
		12	5.2-		12	5.4-	
19		12	6.3+		12	6.1+	
		12	6.1-		12	6.3-	
20		12	7.3+		12	6.2+	
		12	6.2-		12	7.3-	
21		12	7.3+		12	6.2+	
		12	6.2-		12	7.3-	
22		12	8.1+		12	7.1+	
		12	7.1-		12	8.1-	
23		12	7.1-		12	11.1-	
		12	11.1+		12	7.1+	
24		12	10.1+		12	7.1+	
		12	7.1-		12	10.1-	
25		12	9.1+		12	7.1+	
		12	7.1-		12	9.1-	
26		12	7.4+		12	7.2+	
		12	7.2-		12	7.4-	
27		12	12.2+		12	8.3+	
		12	8.3-		12	12.2-	
28		12	12.2+		12	9.3+	
		12	9.3-		12	12.2-	
29		12	12.2+		12	10.3+	
		12	10.3-		12	12.2-	
30		12	11.3-		12	12.2-	
		12	12.2+		12	11.3+	

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31	12	12.3+	12	12.1+	
	12	12.1-	12	12.3-	
32	12	13.3+	12	12.4+	
	12	12.4-	12	13.3-	
33	12	13.3+	12	12.4+	
	12	12.4-	12	13.3-	
34	12	13.1-	12	14.3-	
	12	14.3+	12	13.1+	
35	12	13.1-	12	14.3-	
	12	14.3+	12	13.1+	
36	12	13.4+	12	13.2+	
	12	13.2-	12	13.4-	
37	12	14.1-	12	21.4-	
	12	21.4+	12	14.1+	
38	12	14.1-	12	17.4-	
	12	17.4+	12	14.1+	
39	12	14.1-	12	16.4-	
	12	16.4+	12	14.1+	
40	12	14.1-	12	15.4-	
	12	15.4+	12	14.1+	
41	12	14.4+	12	14.2+	
	12	14.2-	12	14.4-	
42	12	16.3+	12	19.4-	
	12	19.4+	12	15.1+	
	12	15.1-	12	16.3-	
43	12	23.4+	18	32.1+	
	18	32.1-	12	15.2+	
•	12	15.2-	12	23.4-	
44	12	21.1+	12	22.4+	
	12	22.4-	12	15.3+	
	12	15.3-	12	21.1-	
45	12	17.3+	12	20.4-	
	12	20.4+	12	16.1+	
	12	16.1-	12	17.3-	
46	12	23.4+	18	32.1+	
	18	32.1-	12	16.2+	
	12	16.2-	12	23.4-	
47	12	21.3+	12	18.4-	
	12	18.4+	12	17.1+	
	12	17.1-	12	21.3-	
48	12	23.4+	18	32.1+	
	18	32.1-	12	17.2+	
	12	17.2-	12	23.4-	
49	12	18.1-	12	18.1+	probable error: unabutted free edge
50	12	18.2-	12	18.2+	probable error: unabutted free edge
51	12	18.3-	18	24.1-	
	18	24.1+	12	18.3+	
52	12	19.1-	12	19.1+	probable error: unabutted free edge
53	12	19.2-	12	19.2+	probable error: unabutted free edge
54	12	19.3-	18	26.1-	
	18	26.1+	12	19.3+	
55	12	20.1-	12	20.1+	probable error: unabutted free edge
56	12	20.2-	12	20.2+	probable error: unabutted free edge
57	12	20.3-	18	27.1-	
	18	27.1+	12	20.3+	
58	12	23.4+	18	32.1+	
	18	32.1-	12	21.2+	

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	12	21.2-	12	23.4-	
59	12	22.1-	12	22.1+	probable error: unabutted free edge
60	12	22.2-	12	22.2+	probable error: unabutted free edge
61	12	22.3-	18	25.1-	
	18	25.1+	12	22.3+	
62	12	23.1-	12	23.3-	
	12	23.3+	12	23.1+	
63	18	24.2-	18	24.2+	
64	18	24.3-	18	24.3+	
65	18	24.4-	18	24.4+	
66	18	25.2-	18	25.2+	
67	18	25.3-	18	25.3+	
68	18	32.2+	18	32.4+	
	18	32.4-	18	25.4+	
	18	25.4-	18	32.2-	
69	18	26.2-	18	26.2+	
70	18	26.3-	18	26.3+	
71	18	26.4-	18	26.4+	
72	18	27.2-	18	27.2+	
73	18	27.3-	18	27.3+	
74	18	27.4-	18	27.4+	
75	18	28.2-	18	28.2+	
76	18	28.3-	18	28.3+	
77	18	28.4-	18	28.4+	
78	18	29.2-	18	29.2+	
79	18	29.3-	18	29.3+	
80	18	29.4-	18	29.4+	
81	18	30.2-	18	30.2+	
82	18	30.3-	18	30.3+	
83	18	30.4-	18	30.4+	
84	18	31.2-	18	31.2+	
85	18	31.3-	18	31.3+	
86	18	31.4-	18	31.4+	
87	18	32.3-	18	32.3+	

surfaces associated with various regions of the configuration

region	nw-id	nw-name	dblt-type	surface	material		r/ctr	
1	1		analysis	upper	air	75.546633	0.341333	-0.739267
	1		analysis	lower	air			
	2		analysis	upper	air			
	2		analysis	lower	air			
	3		analysis	upper	air			
	3		analysis	lower	air			
	4		analysis	upper	air			
	4		analysis	lower	air			
	5		analysis	upper	air			
	6		analysis	upper	air			
	7		analysis	upper	air			
	8		analysis	upper	air			
	9		analysis	upper	air			
	10		analysis	upper	air			
	11		analysis	upper	air			
	12		analysis	upper	air			
	13		analysis	upper	air			
	14		analysis	upper	air			
	15		analysis	upper	air			

```
             16          analysis     upper   air
             17          analysis     upper   air
             18          analysis     upper   air
             18          analysis     lower   air
             19          analysis     upper   air
             19          analysis     lower   air
             20          analysis     upper   air
             20          analysis     lower   air
             21          analysis     upper   air
             22          analysis     upper   air
             22          analysis     lower   air
             24          nt=18 wake   upper   air
             24          nt=18 wake   lower   air
             25          nt=18 wake   upper   air
             25          nt=18 wake   lower   air
             26          nt=18 wake   upper   air
             26          nt=18 wake   lower   air
             27          nt=18 wake   upper   air
             27          nt=18 wake   lower   air
             28          nt=18 wake   upper   air
             28          nt=18 wake   lower   air
             29          nt=18 wake   upper   air
             29          nt=18 wake   lower   air
             30          nt=18 wake   upper   air
             30          nt=18 wake   lower   air
             31          nt=18 wake   upper   air
             31          nt=18 wake   lower   air
             32          nt=18 wake   lower   air

      2       5          analysis     lower   air      68.013867   0.854933   -1.775733
              6          analysis     lower   air
              7          analysis     lower   air
              8          analysis     lower   air
              9          analysis     lower   air
             10          analysis     lower   air
             11          analysis     lower   air
             12          analysis     lower   air
             13          analysis     lower   air
             14          analysis     lower   air
             15          analysis     lower   air
             16          analysis     lower   air
             17          analysis     lower   air
             21          analysis     lower   air
             23          analysis     lower   air

      3      23          analysis     upper   air     160.353000   2.584000   -4.458000
             32          nt=18 wake   upper   air

 0*b*extra-cp

 0 *****  summary of extra control points  *****

          nw  edge  point  row  col    fine grid location
     1.    6     2     11   11    2      21    3
     2.    7     1      4    1    4       1    7
     3.    7     1      7    1    7       1   13
```

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```
     4.   7     1      10    1   10       1   19
     5.   7     3      11    3    3       5    5
     6.  12     2       4    4    3       7    5
     7.  12     2       7    7    3      13    5
     8.  12     2      10   10    3      19    5
     9.  12     4       3   11    1      21    1
    10.  13     1      12    1   12       1   23
    11.  13     3       3    2   11       3   21
    12.  14     1       4    1    4       1    7
    13.  14     1       7    1    7       1   13
    14.  14     1      10    1   10       1   19
    15.  14     3      12    4    2       7    3
    16.  23     4       4   10    1      19    1
    17.  23     4       7    7    1      13    1
    18.  23     4      10    4    1       7    1
    19.  32     1       4    1    4       1    7
    20.  32     1       7    1    7       1   13
    21.  32     1      10    1   10       1   19
0*e*extra-cp
0*b*extra-vp


0 *****  summary of extra v-parameter points  *****

        nw   edge   point  row   col    fine grid location
     1.   6     2      11   11    2      21    3
     2.   7     1       4    1    4       1    7
     3.   7     1       7    1    7       1   13
     4.   7     1      10    1   10       1   19
     5.   7     3      11    3    3       5    5
     6.  12     2       4    4    3       7    5
     7.  12     2       7    7    3      13    5
     8.  12     2      10   10    3      19    5
     9.  12     4       3   11    1      21    1
    10.  13     1      12    1   12       1   23
    11.  13     3       3    2   11       3   21
    12.  14     1       4    1    4       1    7
    13.  14     1       7    1    7       1   13
    14.  14     1      10    1   10       1   19
    15.  14     3      12    4    2       7    3
    16.  23     4       4   10    1      19    1
    17.  23     4       7    7    1      13    1
    18.  23     4      10    4    1       7    1
    19.  32     1       4    1    4       1    7
    20.  32     1       7    1    7       1   13
    21.  32     1      10    1   10       1   19
0*e*extra-vp
0*b*abutment
1                                abutment summary


0abutment #    1
                    dblt edge                              starts at ai #    1       ends at ai #    2
  nw.edge   nw/id   type type   matching   kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   1.1               12    4                              1    2    3    4    5    6    7    8    9
  30.1               18    5    mu-match                  1    2    3    4    5    6    7    8    9
0abutment #    2     doublet strength matched to zero along this abutment                                  ***  warning  **
```

```
*
                    dblt edge                          starts at ai #   2      ends at ai #   3
  nw.edge   nw/id   type type   matching   kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   1.2               12    4    mu-match                  1   2   3   4   5   6   7   8   9
0abutment #   3      doublet strength matched to zero along this abutment                                   ***  warning  **
*
                    dblt edge                          starts at ai #   3      ends at ai #   4
  nw.edge   nw/id   type type   matching   kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   1.3               12    4    mu-match                  1   2   3   4   5   6   7   8   9
0abutment #   4
                    dblt edge                          starts at ai #   1      ends at ai #   4
  nw.edge   nw/id   type type   matching   kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   1.4               12    4    mu-match                  1   2   3   4   5   6   7   8   9
  10.2               12    4                              1   0   0   0   0   0   0   0   2
  11.4               12    4                              2   0   0   0   0   0   0   0   1
0abutment #   5
                    dblt edge                          starts at ai #   5      ends at ai #   6
  nw.edge   nw/id   type type   matching   kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   2.1               12    4                              1   2   3   4   5   6   7   8   9
  29.1               18    5    mu-match                  1   2   3   4   5   6   7   8   9
0abutment #   6      doublet strength matched to zero along this abutment                                   ***  warning  **
*
                    dblt edge                          starts at ai #   6      ends at ai #   7
  nw.edge   nw/id   type type   matching   kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   2.2               12    4    mu-match                  1   2   3   4   5   6   7   8   9
0abutment #   7      doublet strength matched to zero along this abutment                                   ***  warning  **
*
                    dblt edge                          starts at ai #   7      ends at ai #   8
  nw.edge   nw/id   type type   matching   kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   2.3               12    4    mu-match                  1   2   3   4   5   6   7   8   9
0abutment #   8
                    dblt edge                          starts at ai #   5      ends at ai #   8
  nw.edge   nw/id   type type   matching   kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   2.4               12    4    mu-match                  1   2   3   4   5   6   7   8   9
   9.2               12    4                              1   0   0   0   0   0   0   0   2
  10.4               12    4                              2   0   0   0   0   0   0   0   1
0abutment #   9
                    dblt edge                          starts at ai #   9      ends at ai #  10
  nw.edge   nw/id   type type   matching   kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   3.1               12    4                              1   2   3   4   5   6   7   8   9
  31.1               18    5    mu-match                  1   2   3   4   5   6   7   8   9
0abutment #  10      doublet strength matched to zero along this abutment                                   ***  warning  **
*
                    dblt edge                          starts at ai #  10      ends at ai #  11
  nw.edge   nw/id   type type   matching   kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   3.2               12    4    mu-match                  1   2   3   4   5   6   7   8   9
0abutment #  11      doublet strength matched to zero along this abutment                                   ***  warning  **
*
                    dblt edge                          starts at ai #  11      ends at ai #  12
  nw.edge   nw/id   type type   matching   kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   3.3               12    4    mu-match                  1   2   3   4   5   6   7   8   9
0abutment #  12
                    dblt edge                          starts at ai #  12      ends at ai #   9
  nw.edge   nw/id   type type   matching   kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   3.4               12    4    mu-match                  1   2   3   4   5   6   7   8   9
   8.4               12    4                              2   0   0   0   0   0   0   0   1
  11.2               12    4                              1   0   0   0   0   0   0   0   2
```

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0abutment #  13
                        dblt edge
  nw.edge   nw/id       type type   matching   kutta-fl     starts at ai #  13       ends at ai #  14
   4.1                   12    4                            corresponding edge points ( minus (-) indicates point moved by $eat
   28.1                  18    5    mu-match                  1   2   3   4   5   6   7   8   9
0abutment #  14                                               1   2   3   4   5   6   7   8   9
*                        doublet strength matched to zero along this abutment
                                                                                                        ***  warning  **
                        dblt edge
  nw.edge   nw/id       type type   matching   kutta-fl     starts at ai #  14       ends at ai #  15
   4.2                   12    4    mu-match                corresponding edge points ( minus (-) indicates point moved by $eat
0abutment #  15                                               1   2   3   4   5   6   7   8   9
*                        doublet strength matched to zero along this abutment
                                                                                                        ***  warning  **
                        dblt edge
  nw.edge   nw/id       type type   matching   kutta-fl     starts at ai #  15       ends at ai #  16
   4.3                   12    4    mu-match                corresponding edge points ( minus (-) indicates point moved by $eat
0abutment #  16                                               1   2   3   4   5   6   7   8   9
                        dblt edge
  nw.edge   nw/id       type type   matching   kutta-fl     starts at ai #  13       ends at ai #  16
   4.4                   12    4    mu-match                corresponding edge points ( minus (-) indicates point moved by $eat
   8.2                   12    4                              1   2   3   4   5   6   7   8   9
   9.4                   12    4                              1   0   0   0   0   0   0   0   2
0abutment #  17                                               2   0   0   0   0   0   0   0   1
                        dblt edge
  nw.edge   nw/id       type type   matching   kutta-fl     starts at ai #  17       ends at ai #  17
   5.1                   12    4                            corresponding edge points ( minus (-) indicates point moved by $eat
   6.4                   12    4    mu-match                  1   2   3   4   5   6   7   8   9  10  11  12  13
0abutment #  18                                              13  12  11  10   9   8   7   6   5   4   3   2   1
                        dblt edge
  nw.edge   nw/id       type type   matching   kutta-fl     starts at ai #  18       ends at ai #  17
   5.2                   12    4    mu-match                corresponding edge points ( minus (-) indicates point moved by $eat
   5.4                   12    4                              1  -2   3   4
0abutment #  19                                               4  -3   2   1
                        dblt edge
  nw.edge   nw/id       type type   matching   kutta-fl     starts at ai #  19       ends at ai #  17
   6.1                   12    4    mu-match                corresponding edge points ( minus (-) indicates point moved by $eat
   6.3                   12    4                              1   2
0abutment #  20                                               2   1
                        dblt edge
  nw.edge   nw/id       type type   matching   kutta-fl     starts at ai #  20       ends at ai #  19
   6.2                   12    4                            corresponding edge points ( minus (-) indicates point moved by $eat
   7.3                   12    4    mu-match                  1   2   3   4   5   6   7   8   9  10  11
0abutment #  21                                              11  10   9   8   7   6   5   4   3   2   1
                        dblt edge
  nw.edge   nw/id       type type   matching   kutta-fl     starts at ai #  19       ends at ai #  20
   6.2                   12    4                            corresponding edge points ( minus (-) indicates point moved by $eat
   7.3                   12    4    mu-match                 11  12  13
0abutment #  22                                              13  12  11
                        dblt edge
  nw.edge   nw/id       type type   matching   kutta-fl     starts at ai #  12       ends at ai #  16
   7.1                   12    4                            corresponding edge points ( minus (-) indicates point moved by $eat
   8.1                   12    4    mu-match                  1   2   3   4
0abutment #  23                                               4   3   2   1
                        dblt edge
  nw.edge   nw/id       type type   matching   kutta-fl     starts at ai #   4       ends at ai #  12
   7.1                   12    4                            corresponding edge points ( minus (-) indicates point moved by $eat
   11.1                  12    4    mu-match                  4   5   6   7
0abutment #  24                                               4   3   2   1
```

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                     dblt edge                       starts at ai #   8      ends at ai #   4
 nw.edge   nw/id    type type   matching   kutta-fl  corresponding edge points ( minus (-) indicates point moved by $eat
  7.1                12    4                           7   8   9  10
  10.1               12    4    mu-match               4   3   2   1
0abutment #  25
                     dblt edge                       starts at ai #  16      ends at ai #   8
 nw.edge   nw/id    type type   matching   kutta-fl  corresponding edge points ( minus (-) indicates point moved by $eat
  7.1                12    4                          10  11  12  13
  9.1                12    4    mu-match               4   3   2   1
0abutment #  26
                     dblt edge                       starts at ai #  20      ends at ai #  16
 nw.edge   nw/id    type type   matching   kutta-fl  corresponding edge points ( minus (-) indicates point moved by $eat
  7.2                12    4    mu-match               1   2   3
  7.4                12    4                           3   2   1
0abutment #  27
                     dblt edge                       starts at ai #   9      ends at ai #  13
 nw.edge   nw/id    type type   matching   kutta-fl  corresponding edge points ( minus (-) indicates point moved by $eat
  8.3                12    4                           1   2   3   4
  12.2               12    4    mu-match              13  12  11  10
0abutment #  28
                     dblt edge                       starts at ai #  13      ends at ai #   5
 nw.edge   nw/id    type type   matching   kutta-fl  corresponding edge points ( minus (-) indicates point moved by $eat
  9.3                12    4                           1   2   3   4
  12.2               12    4    mu-match               4   3   2   1
0abutment #  29
                     dblt edge                       starts at ai #   5      ends at ai #   1
 nw.edge   nw/id    type type   matching   kutta-fl  corresponding edge points ( minus (-) indicates point moved by $eat
  10.3               12    4                           1   2   3   4
  12.2               12    4    mu-match               7   6   5   4
0abutment #  30
                     dblt edge                       starts at ai #   1      ends at ai #   9
 nw.edge   nw/id    type type   matching   kutta-fl  corresponding edge points ( minus (-) indicates point moved by $eat
  11.3               12    4                           1   2   3   4
  12.2               12    4    mu-match              10   9   8   7
0abutment #  31
                     dblt edge                       starts at ai #  13      ends at ai #  21
 nw.edge   nw/id    type type   matching   kutta-fl  corresponding edge points ( minus (-) indicates point moved by $eat
  12.1               12    4                           1   2   3
  12.3               12    4    mu-match               3   2   1
0abutment #  32
                     dblt edge                       starts at ai #  22      ends at ai #  21
 nw.edge   nw/id    type type   matching   kutta-fl  corresponding edge points ( minus (-) indicates point moved by $eat
  12.4               12    4                           1   2   3
  13.3               12    4    mu-match               3   2   1
0abutment #  33
                     dblt edge                       starts at ai #  21      ends at ai #  22
 nw.edge   nw/id    type type   matching   kutta-fl  corresponding edge points ( minus (-) indicates point moved by $eat
  12.4               12    4                           3   4   5   6   7   8   9  10  11  12  13
  13.3               12    4    mu-match              13  12  11  10   9   8   7   6   5   4   3
0abutment #  34
                     dblt edge                       starts at ai #  24      ends at ai #  23
 nw.edge   nw/id    type type   matching   kutta-fl  corresponding edge points ( minus (-) indicates point moved by $eat
  13.1               12    4                           1   2   3   4   5   6   7   8   9  10  11  12
  14.3               12    4    mu-match              12  11  10   9   8   7   6   5   4   3   2   1
0abutment #  35
                     dblt edge                       starts at ai #  23      ends at ai #  24
 nw.edge   nw/id    type type   matching   kutta-fl  corresponding edge points ( minus (-) indicates point moved by $eat
```

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  13.1             12    4                          12  13
  14.3             12    4   mu-match               13  12
0abutment #  36
                   dblt edge                       starts at ai #  22      ends at ai #  23
  nw.edge  nw/id   type type   matching  kutta-fl   corresponding edge points ( minus (-) indicates point moved by $eat
  13.2             12    4   mu-match                 1   2
  13.4             12    4                            2   1
0abutment #  37
                   dblt edge                       starts at ai #  26      ends at ai #  25
  nw.edge  nw/id   type type   matching  kutta-fl   corresponding edge points ( minus (-) indicates point moved by $eat
  14.1             12    4                            1   2   3   4
  21.4             12    4   mu-match                 4   3   2   1
0abutment #  38
                   dblt edge                       starts at ai #  27      ends at ai #  26
  nw.edge  nw/id   type type   matching  kutta-fl   corresponding edge points ( minus (-) indicates point moved by $eat
  14.1             12    4                            4   5   6   7
  17.4             12    4   mu-match                 4   3   2   1
0abutment #  39
                   dblt edge                       starts at ai #  28      ends at ai #  27
  nw.edge  nw/id   type type   matching  kutta-fl   corresponding edge points ( minus (-) indicates point moved by $eat
  14.1             12    4                            7  -8   9  10
  16.4             12    4   mu-match                 4  -3   2   1
0abutment #  40
                   dblt edge                       starts at ai #  25      ends at ai #  28
  nw.edge  nw/id   type type   matching  kutta-fl   corresponding edge points ( minus (-) indicates point moved by $eat
  14.1             12    4                           10 -11  12  13
  15.4             12    4   mu-match                 4  -3   2   1
0abutment #  41
                   dblt edge                       starts at ai #  24      ends at ai #  25
  nw.edge  nw/id   type type   matching  kutta-fl   corresponding edge points ( minus (-) indicates point moved by $eat
  14.2             12    4                            1   2   3   4
  14.4             12    4   mu-match                 4   3   2   1
0abutment #  42
                   dblt edge                       starts at ai #  29      ends at ai #  28
  nw.edge  nw/id   type type   matching  kutta-fl   corresponding edge points ( minus (-) indicates point moved by $eat
  15.1             12    4   mu-match                 1   2   3   4   5   6   7   8   9  10  11
  16.3             12    4                           11  10   9   8   7   6   5   4   3   2   1
  19.4             12    4                           11  10   9   8   7   6   5   4   3   2   1
0abutment #  43
                   dblt edge                       starts at ai #  29      ends at ai #  30
  nw.edge  nw/id   type type   matching  kutta-fl   corresponding edge points ( minus (-) indicates point moved by $eat
  15.2             12    4                            1  -2   3   4
  23.4             12    4                            4  -3   2   1
  32.1             18    5   mu-match                10 -11  12  13
0abutment #  44
                   dblt edge                       starts at ai #  30      ends at ai #  25
  nw.edge  nw/id   type type   matching  kutta-fl   corresponding edge points ( minus (-) indicates point moved by $eat
  15.3             12    4                            1   2   3   4   5  -6  -7   8   9 -10  11
  21.1             12    4   mu-match                11  10   9   8   7  -6  -5   4   3  -2   1
  22.4             12    4                            1   2   3   4   5  -6  -7   8   9 -10  11
0abutment #  45
                   dblt edge                       starts at ai #  31      ends at ai #  27
  nw.edge  nw/id   type type   matching  kutta-fl   corresponding edge points ( minus (-) indicates point moved by $eat
  16.1             12    4                            1   2   3   4   5   6   7   8   9  10  11
  17.3             12    4   mu-match                11  10   9   8   7   6   5   4   3   2   1
  20.4             12    4                           11  10   9   8   7   6   5   4   3   2   1
0abutment #  46
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                  dblt edge                                starts at ai #  31      ends at ai #  29
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  16.2            12    4                             1   2   3   4
  23.4            12    4                             7   6   5   4
  32.1            18    5    mu-match                 7   8   9  10
0abutment #  47
                  dblt edge                                starts at ai #  32      ends at ai #  26
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  17.1            12    4                             1  -2   3   4  -5  -6   7   8   9  10  11
  18.4            12    4                            11 -10   9   8  -7  -6   5   4   3   2   1
  21.3            12    4    mu-match                11 -10   9   8  -7  -6   5   4   3   2   1
0abutment #  48
                  dblt edge                                starts at ai #  32      ends at ai #  31
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  17.2            12    4                             1   2   3   4
  23.4            12    4                            10   9   8   7
  32.1            18    5    mu-match                 4   5   6   7
0abutment #  49    doublet strength matched to zero along this abutment                                    *** warning **
*
                  dblt edge                                starts at ai #  26      ends at ai #  33
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  18.1            12    4    mu-match                 1   2   3   4   5   6   7
0abutment #  50    doublet strength matched to zero along this abutment                                    *** warning **
*
                  dblt edge                                starts at ai #  33      ends at ai #  34
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  18.2            12    4    mu-match                 1   2   3   4   5   6   7   8   9  10  11
0abutment #  51
                  dblt edge                                starts at ai #  32      ends at ai #  34
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  18.3            12    4    vor-mtch                 1   2   3   4   5   6   7
  24.1            18    5    mu-match  vor-mtch       7   6   5   4   3   2   1
0abutment #  52    doublet strength matched to zero along this abutment                                    *** warning **
*
                  dblt edge                                starts at ai #  28      ends at ai #  35
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  19.1            12    4    mu-match                 1   2   3   4   5   6   7
0abutment #  53    doublet strength matched to zero along this abutment                                    *** warning **
*
                  dblt edge                                starts at ai #  35      ends at ai #  36
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  19.2            12    4    mu-match                 1   2   3   4   5   6   7   8   9  10  11
0abutment #  54
                  dblt edge                                starts at ai #  29      ends at ai #  36
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  19.3            12    4    vor-mtch                 1   2   3   4   5   6   7
  26.1            18    5    mu-match  vor-mtch       7   6   5   4   3   2   1
0abutment #  55    doublet strength matched to zero along this abutment                                    *** warning **
*
                  dblt edge                                starts at ai #  27      ends at ai #  37
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  20.1            12    4    mu-match                 1   2   3   4   5   6   7
0abutment #  56    doublet strength matched to zero along this abutment                                    *** warning **
*
                  dblt edge                                starts at ai #  37      ends at ai #  38
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  20.2            12    4    mu-match                 1   2   3   4   5   6   7   8   9  10  11
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0abutment #  57
                     dblt edge                             starts at ai #  31       ends at ai #  38
  nw.edge   nw/id    type type   matching   kutta-fl       corresponding edge points ( minus (-) indicates point moved by $eat
   20.3               12   4     vor-mtch                     1   2   3   4   5   6   7
   27.1               18   5     mu-match   vor-mtch          7   6   5   4   3   2   1
0abutment #  58
                     dblt edge                             starts at ai #  30       ends at ai #  32
  nw.edge   nw/id    type type   matching   kutta-fl       corresponding edge points ( minus (-) indicates point moved by $eat
   21.2               12   4                                  1  -2   3   4
   23.4               12   4                                 13 -12  11  10
   32.1               18   5     mu-match                     1  -2   3   4
0abutment #  59      doublet strength matched to zero along this abutment
*                                                                                                        ***  warning  **
                     dblt edge                             starts at ai #  25       ends at ai #  39
  nw.edge   nw/id    type type   matching   kutta-fl       corresponding edge points ( minus (-) indicates point moved by $eat
   22.1               12   4     mu-match                     1   2   3   4   5   6   7
0abutment #  60      doublet strength matched to zero along this abutment
*                                                                                                        ***  warning  **
                     dblt edge                             starts at ai #  39       ends at ai #  40
  nw.edge   nw/id    type type   matching   kutta-fl       corresponding edge points ( minus (-) indicates point moved by $eat
   22.2               12   4     mu-match                     1   2   3   4   5   6   7   8   9  10  11
0abutment #  61
                     dblt edge                             starts at ai #  30       ends at ai #  40
  nw.edge   nw/id    type type   matching   kutta-fl       corresponding edge points ( minus (-) indicates point moved by $eat
   22.3               12   4     vor-mtch                     1   2   3   4   5   6   7
   25.1               18   5     mu-match   vor-mtch          7   6   5   4   3   2   1
0abutment #  62
                     dblt edge                             starts at ai #  41       ends at ai #  30
  nw.edge   nw/id    type type   matching   kutta-fl       corresponding edge points ( minus (-) indicates point moved by $eat
   23.1               12   4     mu-match                     1   2
   23.3               12   4                                  2   1
0abutment #  63      wake side edge left unabutted
*                                                                                                        ***  warning  **
                     dblt edge                             starts at ai #  34       ends at ai #  42
  nw.edge   nw/id    type type   matching   kutta-fl       corresponding edge points ( minus (-) indicates point moved by $eat
   24.2               18   2                                  1   2
0abutment #  64      wake trailing edge unabutted.  wake filaments will be added
*                                                                                                   *** gentle reminder **
                     dblt edge                             starts at ai #  42       ends at ai #  43
  nw.edge   nw/id    type type   matching   kutta-fl       corresponding edge points ( minus (-) indicates point moved by $eat
   24.3               18   2                                  1   2   3   4   5   6   7
0abutment #  65      wake side edge left unabutted
*                                                                                                        ***  warning  **
                     dblt edge                             starts at ai #  43       ends at ai #  32
  nw.edge   nw/id    type type   matching   kutta-fl       corresponding edge points ( minus (-) indicates point moved by $eat
   24.4               18   2                                  1   2
0abutment #  66      wake side edge left unabutted
*                                                                                                        ***  warning  **
                     dblt edge                             starts at ai #  40       ends at ai #  44
  nw.edge   nw/id    type type   matching   kutta-fl       corresponding edge points ( minus (-) indicates point moved by $eat
   25.2               18   2                                  1   2
0abutment #  67      wake trailing edge unabutted.  wake filaments will be added
*                                                                                                   *** gentle reminder **
                     dblt edge                             starts at ai #  44       ends at ai #  45
  nw.edge   nw/id    type type   matching   kutta-fl       corresponding edge points ( minus (-) indicates point moved by $eat
   25.3               18   2                                  1   2   3   4   5   6   7
0abutment #  68
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                        dblt edge
 nw.edge   nw/id        type type   matching   kutta-fl
  25.4                   18    2
  32.2                   18    2
  32.4                   18    2
0abutment #   69         wake side edge left unabutted
*
starts at ai #  45      ends at ai #  30
corresponding edge points ( minus (-) indicates point moved by $eat
  1   2
  2   1
  1   2                                                      *** warning **

                        dblt edge
 nw.edge   nw/id        type type   matching   kutta-fl
  26.2                   18    2
0abutment #   70         wake trailing edge unabutted.
*
starts at ai #  36      ends at ai #  46
corresponding edge points ( minus (-) indicates point moved by $eat
  1   2                                             *** gentle reminder **
wake filaments will be added

                        dblt edge
 nw.edge   nw/id        type type   matching   kutta-fl
  26.3                   18    2
0abutment #   71         wake side edge left unabutted
*
starts at ai #  46      ends at ai #  47
corresponding edge points ( minus (-) indicates point moved by $eat
  1   2   3   4   5   6   7                                  *** warning **

                        dblt edge
 nw.edge   nw/id        type type   matching   kutta-fl
  26.4                   18    2
0abutment #   72         wake side edge left unabutted
*
starts at ai #  47      ends at ai #  29
corresponding edge points ( minus (-) indicates point moved by $eat
  1   2                                                      *** warning **

                        dblt edge
 nw.edge   nw/id        type type   matching   kutta-fl
  27.2                   18    2
0abutment #   73         wake trailing edge unabutted.
*
starts at ai #  38      ends at ai #  48
corresponding edge points ( minus (-) indicates point moved by $eat
  1   2                                             *** gentle reminder **
wake filaments will be added

                        dblt edge
 nw.edge   nw/id        type type   matching   kutta-fl
  27.3                   18    2
0abutment #   74         wake side edge left unabutted
*
starts at ai #  48      ends at ai #  49
corresponding edge points ( minus (-) indicates point moved by $eat
  1   2   3   4   5   6   7                                  *** warning **

                        dblt edge
 nw.edge   nw/id        type type   matching   kutta-fl
  27.4                   18    2
0abutment #   75         wake side edge left unabutted
*
starts at ai #  49      ends at ai #  31
corresponding edge points ( minus (-) indicates point moved by $eat
  1   2                                                      *** warning **

                        dblt edge
 nw.edge   nw/id        type type   matching   kutta-fl
  28.2                   18    2
0abutment #   76         wake trailing edge unabutted.
*
starts at ai #  14      ends at ai #  50
corresponding edge points ( minus (-) indicates point moved by $eat
  1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
                                                    *** gentle reminder **
wake filaments will be added

                        dblt edge
 nw.edge   nw/id        type type   matching   kutta-fl
  28.3                   18    2
0abutment #   77         wake side edge left unabutted
*
starts at ai #  50      ends at ai #  51
corresponding edge points ( minus (-) indicates point moved by $eat
  1   2   3   4   5   6   7   8   9                          *** warning **

                        dblt edge
 nw.edge   nw/id        type type   matching   kutta-fl
  28.4                   18    2
0abutment #   78         wake side edge left unabutted
*
starts at ai #  51      ends at ai #  13
corresponding edge points ( minus (-) indicates point moved by $eat
  1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
                                                             *** warning **

                        dblt edge
 nw.edge   nw/id        type type   matching   kutta-fl
  29.2                   18    2
0abutment #   79         wake trailing edge unabutted.
*
starts at ai #   6      ends at ai #  52
corresponding edge points ( minus (-) indicates point moved by $eat
  1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
                                                    *** gentle reminder **
wake filaments will be added
```

```
                   dblt edge                        starts at ai #  52      ends at ai #  53
  nw.edge  nw/id   type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  29.3              18   2                             1   2   3   4   5   6   7   8   9
0abutment #  80     wake side edge left unabutted                                                         ***  warning  **
*
                   dblt edge                        starts at ai #  53      ends at ai #   5
  nw.edge  nw/id   type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  29.4              18   2                             1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
0abutment #  81     wake side edge left unabutted                                                         ***  warning  **
*
                   dblt edge                        starts at ai #   2      ends at ai #  54
  nw.edge  nw/id   type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  30.2              18   2                             1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
0abutment #  82     wake trailing edge unabutted.  wake filaments will be added                      *** gentle reminder **
*
                   dblt edge                        starts at ai #  54      ends at ai #  55
  nw.edge  nw/id   type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  30.3              18   2                             1   2   3   4   5   6   7   8   9
0abutment #  83     wake side edge left unabutted                                                         ***  warning  **
*
                   dblt edge                        starts at ai #  55      ends at ai #   1
  nw.edge  nw/id   type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  30.4              18   2                             1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
0abutment #  84     wake side edge left unabutted                                                         ***  warning  **
*
                   dblt edge                        starts at ai #  10      ends at ai #  56
  nw.edge  nw/id   type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  31.2              18   2                             1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
0abutment #  85     wake trailing edge unabutted.  wake filaments will be added                      *** gentle reminder **
*
                   dblt edge                        starts at ai #  56      ends at ai #  57
  nw.edge  nw/id   type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  31.3              18   2                             1   2   3   4   5   6   7   8   9
0abutment #  86     wake side edge left unabutted                                                         ***  warning  **
*
                   dblt edge                        starts at ai #  57      ends at ai #   9
  nw.edge  nw/id   type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  31.4              18   2                             1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
0abutment #  87     wake trailing edge unabutted.  wake filaments will be added                      *** gentle reminder **
*
                   dblt edge                        starts at ai #  45      ends at ai #  45
  nw.edge  nw/id   type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  32.3              18   2                             1   2   3   4   5   6   7   8   9  10  11  12  13
0*e*abutment
0*b*nwedgmov
1          *****  movement of network edge points  *****
  nw.edge          motion
  dz(max)           dz(i)

   5.2       ** .lt. eps **      tolerance =   0.1911E-02
   0.50E-03    0.000000     0.000500     0.000000     0.000000
   1 orig x    8.499000     2.498000     0.482000     0.000000
          y    0.000000     0.000000     0.000000     0.000000
          z    3.999000     3.565000     1.853000     0.000000
    moved x    8.499000     2.498000     0.482000     0.000000
          y    0.000000     0.000000     0.000000     0.000000
```

APPENDIX C. GBU-24 OUTPUT FILE (UNIT NORMALS)


```
 nwltrf/in              9
       1.          24         25         26         27         28         29         30         31         32


 =====  summary of networks for trefftz plane analysis  =====

   nw   network-id
   ---  ----------
 nwltrf/out             9
       1.          24         25         26         27         28         29         30         31         32

   24
   25
   26
   27
   28
   29
   30
   31
   32

   t/abtidn      2.099325
  abtcal/anl     0.000034
 0*e*libgeoab
 0 control points for network :   1
     jc  jc/naive             zc                                     znc                          nw panel.sp jzc ifn jfn izdc abut fseg  ta
 u
     1     1    45.090395   3.246673   -2.414971   0.000000   0.641888   0.766799    1     1.1     1   1   1    1    1    1 0.0
 000
     2     2    43.834818   3.232000   -2.402644   0.000149   0.641734   0.766927    1     1.8     2   2   1    4    4    4 0.9
 375
     3     3    41.158462   3.232000   -2.402625   0.000000   0.641588   0.767049    1     2.8     3   4   1    4    4    4 0.8
 125
     4     4    38.481511   3.232000   -2.402625   0.000000   0.641588   0.767049    1     3.8     4   6   1    4    4    4 0.6
 875
     5     5    35.804544   3.232000   -2.402580   0.000149   0.641392   0.767213    1     4.8     5   8   1    4    4    4 0.5
 625
     6     6    33.127182   3.232000   -2.402562   0.000000   0.641288   0.767301    1     5.8     6  10   1    4    4    4 0.4
 375
     7     7    30.449590   3.232000   -2.402562   0.000000   0.641288   0.767301    1     6.8     7  12   1    4    4    4 0.3
 125
     8     8    27.771476   3.232000   -2.402515   0.000149   0.641050   0.767499    1     7.8     8  14   1    4    4    4 0.1
 875
     9     9    25.093237   3.230462   -2.401216   0.000000   0.640987   0.767552    1     8.8     9  16   1    4    4    4 0.0
 625
    10    10    24.013415   3.231929   -2.402441   0.000000   0.640987   0.767552    1     8.4    10  17   1    5    3    3 1.0
 000
    11    11    45.085496   3.858495   -2.927114   0.000149   0.641734   0.766927    1     1.5    11   1   2   -1    0    1 0.0
 625
    12    12    43.930127   3.885736   -2.949683   0.000149   0.641734   0.766927    1     1.5    12   2   2    0    0    0 0.0
 000
    13    13    41.359743   3.885756   -2.949450   0.000000   0.641588   0.767049    1     2.5    13   4   2    0    0    0 0.0
 000
    14    14    38.789418   3.885803   -2.949489   0.000000   0.641588   0.767049    1     3.5    14   6   2    0    0    0 0.0
 000
    15    15    36.219655   3.885870   -2.949298   0.000149   0.641392   0.767213    1     4.5    15   8   2    0    0    0 0.0
```

APPENDIX D. GBU-24 OUTPUT FILE (SOLUTION DATA)


```
 pic counts                              panel/source  panel/doublet   block/source  block/doublet

 no influence                                   0             0              0              0
 monopole far field                        140654        614894              0              0
 dipole far field                           68550        341612              0              0
 quadrupole far field                       35875        148773              0              0
 one sub-panel intermediate field           32254        120038              0              0
 two sub-panel intermediate field           25193        141840              0              0
 eight sub-panel near field                  1890          6943              0              0


                influence coefficient generation i/o count
ncalg=       0   nwrdg=          0   ncalt=       0   nwrdt=          0
 n56chg:            4
    1.         0        16313      112589       16313

0logical flags for cp/2 iteration:
        F = bkprnt, print flag for solver statistics
 wopen call on unit   19  blocks:   100   status:     0
0
               ***********************************
               *                                 *
               *       condition indicators      *
               *                                 *
               *  uniform solution 0.257794E-12  *
               *                                 *
               ***********************************
1
0*b*solution
                                       simultaneous solution number    1


 mach number =    0.80000    angle of attack =    2.00000    sideslip angle =    0.00000    freestream speed =    1.00000
 compressibility factor =    0.60000    compressibility angle of attack =    2.00000    compressibility angle of sideslip =    0.000
00
 freestream velocity = (    0.99939,    0.00000,    0.03490)    compressibility direction = (    0.99939,    0.00000,    0.03490)
1
   network id:              index:   1    source type =   0    doublet type = 12     number rows =   8    number columns =   8

  jc   ip        x          y          z          d0         dx         dy         dz         s0         anx        any        a
nz
  lmachu        wxu        wyu        wzu        pheu       vxu        vyu        vzu        cplinu     cpslnu     cp2ndu     cpi
snu
  lmachl        wxl        wyl        wzl        phel       vxl        vyl        vzl        cplinl     cpslnl     cp2ndl     cpi
snl
     wnu        wnl        pwnu       pwnl       vtu        vtl        pvtu       pvtl       cplind     cpslnd     cp2ndd     cpi
snd

   12    1    43.9301     3.8857    -2.9497     0.4701    -0.0365     0.1604    -0.1352     0.0000     0.0000     0.0196     0
.0234
     0.7580     0.9818     0.0789    -0.0662    -0.6205     0.9443     0.0789    -0.0675     0.1172     0.1009     0.0997     0
```

.0990												
	0.7889	0.9920	-0.0815	0.0680	-1.0905	0.9809	-0.0815	0.0676	0.0348	0.0270	0.0269	0
.0268												
	0.0000	0.0000	-0.0269	-0.0269	0.9500	0.9866	0.1377	0.0856	0.0825	0.0739	0.0728	0
.0722												
13	2	41.3597	3.8858	-2.9495	0.5707	-0.0349	0.0896	-0.0757	0.0000	0.0000	0.0196	0
.0234												
	0.7630	0.9851	0.0430	-0.0360	-0.4911	0.9554	0.0430	-0.0370	0.0930	0.0862	0.0854	0
.0851												
	0.7932	0.9960	-0.0465	0.0389	-1.0617	0.9903	-0.0465	0.0387	0.0179	0.0157	0.0157	0
.0157												
	0.0000	0.0000	-0.0268	-0.0268	0.9571	0.9921	0.0905	0.0392	0.0750	0.0704	0.0697	0
.0694												
14	3	38.7894	3.8858	-2.9495	0.6353	-0.0168	0.0389	-0.0330	0.0000	0.0000	0.0196	0
.0234												
	0.7731	0.9896	0.0174	-0.0145	-0.3976	0.9691	0.0174	-0.0152	0.0641	0.0614	0.0610	0
.0609												
	0.7878	0.9949	-0.0216	0.0181	-1.0330	0.9859	-0.0216	0.0177	0.0281	0.0274	0.0273	0
.0273												
	0.0000	0.0000	-0.0268	-0.0268	0.9694	0.9863	0.0546	0.0146	0.0359	0.0340	0.0337	0
.0336												
15	4	36.2197	3.8859	-2.9493	0.6558	0.0012	0.0043	-0.0036	0.0000	0.0000	0.0196	0
.0234												
	0.7824	0.9932	-0.0004	0.0002	-0.3345	0.9801	-0.0004	-0.0003	0.0410	0.0398	0.0397	0
.0396												
	0.7814	0.9927	-0.0048	0.0038	-0.9903	0.9790	-0.0048	0.0033	0.0431	0.0421	0.0419	0
.0419												
	0.0000	0.0000	-0.0269	-0.0269	0.9801	0.9790	0.0294	0.0263	-0.0021	-0.0023	-0.0023	-0
.0023												
16	5	33.6500	3.8860	-2.9491	0.6287	0.0201	-0.0166	0.0143	0.0000	0.0000	0.0196	0
.0234												
	0.7916	0.9967	-0.0114	0.0095	-0.2984	0.9905	-0.0114	0.0093	0.0196	0.0189	0.0188	0
.0188												
	0.7739	0.9898	0.0051	-0.0043	-0.9271	0.9704	0.0051	-0.0050	0.0608	0.0592	0.0589	0
.0589												
	0.0000	0.0000	-0.0268	-0.0268	0.9906	0.9704	0.0118	0.0414	-0.0411	-0.0404	-0.0401	-0
.0400												
17	6	31.0801	3.8861	-2.9492	0.5518	0.0400	-0.0253	0.0220	0.0000	0.0000	0.0196	0
.0234												
	0.8008	1.0003	-0.0168	0.0140	-0.2883	1.0005	-0.0168	0.0140	-0.0008	-0.0015	-0.0015	-0
.0015												
	0.7654	0.9863	0.0085	-0.0071	-0.8401	0.9606	0.0085	-0.0080	0.0806	0.0788	0.0782	0
.0782												
	0.0000	0.0000	-0.0268	-0.0268	1.0007	0.9606	0.0012	0.0516	-0.0814	-0.0803	-0.0797	-0
.0797												
18	7	28.5100	3.8862	-2.9490	0.4202	0.0661	-0.0279	0.0248	0.0000	0.0000	0.0196	0
.0234												
	0.8131	1.0051	-0.0197	0.0162	-0.3060	1.0140	-0.0197	0.0166	-0.0280	-0.0287	-0.0288	-0
.0288												
	0.7545	0.9818	0.0082	-0.0070	-0.7263	0.9479	0.0082	-0.0082	0.1060	0.1042	0.1032	0
.1031												

```
      0.0000    0.0000   -0.0269   -0.0269    1.0143    0.9479    0.0150    0.0617   -0.1339   -0.1329   -0.1320   -0
.1318

    19     8   25.9399    3.8863   -2.9489    0.2091    0.1259   -0.0564    0.0500    0.0000    0.0000    0.0195    0
.0234
      0.8428    1.0159   -0.0363    0.0303   -0.3655    1.0449   -0.0363    0.0313   -0.0908   -0.0921   -0.0929   -0
.0928
      0.7307    0.9716    0.0201   -0.0168   -0.5745    0.9190    0.0201   -0.0186    0.1644    0.1614    0.1589    0
.1585
      0.0000    0.0000   -0.0268   -0.0268    1.0460    0.9194    0.0522    0.0945   -0.2551   -0.2535   -0.2518   -0
.2513

    22     9   43.9956    5.3899   -4.2081    0.6121   -0.0103    0.0309   -0.0261    0.0000    0.0000    0.0178    0
.0212
      0.7641    0.9858    0.0114   -0.0099   -0.5134    0.9589    0.0114   -0.0109    0.0841    0.0820    0.0813    0
.0812
      0.7731    0.9890   -0.0195    0.0159   -1.1255    0.9693   -0.0195    0.0152    0.0616    0.0609    0.0605    0
.0605
      0.0000    0.0000   -0.0271   -0.0271    0.9591    0.9696    0.0555    0.0302    0.0225    0.0211    0.0208    0
.0207

    23    10   41.6628    5.3899   -4.2076    0.6418   -0.0113    0.0155   -0.0132    0.0000    0.0000    0.0178    0
.0212
      0.7708    0.9885    0.0025   -0.0021   -0.4271    0.9668    0.0025   -0.0028    0.0678    0.0664    0.0660    0
.0660
      0.7807    0.9923   -0.0130    0.0109   -1.0689    0.9781   -0.0130    0.0104    0.0442    0.0435    0.0433    0
.0433
      0.0000    0.0000   -0.0268   -0.0268    0.9668    0.9783    0.0418    0.0220    0.0236    0.0230    0.0227    0
.0227
1
    network id:           index:   1   source type =  0   doublet type = 12    number rows =   8   number columns =   8

   jc   ip        x         y         z        d0        dx        dy        dz        s0       anx       any      a
nz
   lmachu       wxu       wyu       wzu      pheu       vxu       vyu       vzu    cplinu    cpslnu    cp2ndu    cpi
snu
   lmachl       wxl       wyl       wzl      phel       vxl       vyl       vzl    cplinl    cpslnl    cp2ndl    cpi
snl
      wnu       wnl      pwnu      pwnl       vtu       vtl      pvtu      pvtl    cplind    cpslnd    cp2ndd    cpi
snd

    24    11   39.3297    5.3900   -4.2074    0.6593   -0.0025    0.0030   -0.0026    0.0000    0.0000    0.0178    0
.0212
      0.7787    0.9917   -0.0043    0.0034   -0.3620    0.9760   -0.0043    0.0028    0.0490    0.0480    0.0478    0
.0478
      0.7810    0.9925   -0.0073    0.0059   -1.0213    0.9785   -0.0073    0.0054    0.0438    0.0429    0.0427    0
.0427
      0.0000    0.0000   -0.0269   -0.0269    0.9760    0.9786    0.0291    0.0247    0.0053    0.0052    0.0051    0
.0051

    25    12   36.9972    5.3901   -4.2069    0.6518    0.0096   -0.0072    0.0063    0.0000    0.0000    0.0178    0
.0212
      0.7863    0.9946   -0.0095    0.0077   -0.3185    0.9844   -0.0095    0.0073    0.0318    0.0310    0.0309    0
.0309
      0.7778    0.9913   -0.0022    0.0017   -0.9703    0.9749   -0.0022    0.0011    0.0514    0.0503    0.0500    0
.0500
      0.0000    0.0000   -0.0269   -0.0269    0.9845    0.9749    0.0182    0.0316   -0.0196   -0.0193   -0.0192   -0
```

```
.0191
  26     13    34.6651     5.3901    -4.2065     0.6136     0.0236    -0.0160     0.0139     0.0000     0.0000     0.0178     0
.0212
     0.7937     0.9975    -0.0143     0.0117    -0.2934     0.9928    -0.0143     0.0116     0.0149     0.0141     0.0141     0
.0141
     0.7728     0.9893     0.0017    -0.0016    -0.9070     0.9692     0.0017    -0.0023     0.0630     0.0617     0.0613     0
.0613
     0.0000     0.0000    -0.0269    -0.0269     0.9929     0.9692     0.0077     0.0393    -0.0481    -0.0475    -0.0472    -0
.0472

  27     14    32.3324     5.3902    -4.2061     0.5403     0.0398    -0.0247     0.0216     0.0000     0.0000     0.0177     0
.0212
     0.8018     1.0006    -0.0194     0.0160    -0.2881     1.0016    -0.0194     0.0160    -0.0031    -0.0038    -0.0038    -0
.0038
     0.7665     0.9867     0.0053    -0.0047    -0.8284     0.9618     0.0053    -0.0055     0.0780     0.0764     0.0759     0
.0758
     0.0000     0.0000    -0.0269    -0.0269     1.0019     0.9618     0.0036     0.0481    -0.0810    -0.0802    -0.0797    -0
.0796

  28     15    29.9996     5.3903    -4.2057     0.4231     0.0656    -0.0397     0.0347     0.0000     0.0000     0.0177     0
.0212
     0.8146     1.0054    -0.0279     0.0231    -0.3068     1.0152    -0.0279     0.0234    -0.0308    -0.0317    -0.0318    -0
.0318
     0.7561     0.9825     0.0119    -0.0101    -0.7299     0.9496     0.0119    -0.0113     0.1027     0.1006     0.0996     0
.0995
     0.0000     0.0000    -0.0270    -0.0270     1.0159     0.9498     0.0211     0.0630    -0.1335    -0.1323    -0.1314    -0
.1313

  29     16    27.6671     5.3902    -4.2053     0.2271     0.1435    -0.0939     0.0817     0.0000     0.0000     0.0177     0
.0212
     0.8544     1.0192    -0.0565     0.0472    -0.3662     1.0551    -0.0565     0.0485    -0.1124    -0.1157    -0.1169    -0
.1166
     0.7257     0.9693     0.0373    -0.0312    -0.5933     0.9116     0.0373    -0.0333     0.1801     0.1745     0.1716     0
.1709
     0.0000     0.0000    -0.0268    -0.0268     1.0578     0.9130     0.0763     0.1137    -0.2925    -0.2902    -0.2884    -0
.2875

  32     17    44.0611     6.8941    -5.4668     0.6451    -0.0028     0.0028    -0.0024     0.0000     0.0000     0.0160     0
.0191
     0.7693     0.9878    -0.0034     0.0023    -0.4654     0.9651    -0.0034     0.0016     0.0708     0.0697     0.0693     0
.0692
     0.7717     0.9887    -0.0062     0.0047    -1.1105     0.9679    -0.0062     0.0040     0.0651     0.0641     0.0638     0
.0637
     0.0000     0.0000    -0.0271    -0.0271     0.9652     0.9679     0.0391     0.0349     0.0057     0.0056     0.0055     0
.0055

  33     18    41.9658     6.8941    -5.4660     0.6518    -0.0021    -0.0022     0.0018     0.0000     0.0000     0.0160     0
.0191
     0.7750     0.9901    -0.0073     0.0058    -0.4002     0.9717    -0.0073     0.0052     0.0574     0.0565     0.0562     0
.0562
     0.7768     0.9909    -0.0050     0.0040    -1.0521     0.9738    -0.0050     0.0034     0.0534     0.0524     0.0521     0
.0521
     0.0000     0.0000    -0.0269    -0.0269     0.9717     0.9738     0.0308     0.0304     0.0041     0.0041     0.0041     0
.0041

  34     19    39.8703     6.8942    -5.4653     0.6513     0.0039    -0.0078     0.0066     0.0000     0.0000     0.0160     0
```

```
.0191
      0.7814      0.9926     -0.0109      0.0086     -0.3496      0.9789     -0.0109      0.0082      0.0428      0.0420      0.0418      0
.0418
      0.7779      0.9913     -0.0031      0.0021     -1.0010      0.9750     -0.0031      0.0016      0.0511      0.0500      0.0498      0
.0498
      0.0000      0.0000     -0.0271     -0.0271      0.9790      0.9750      0.0223      0.0309     -0.0083     -0.0081     -0.0080     -0
.0080

  35      20     37.7751      6.8943     -5.4646      0.6334      0.0137     -0.0133      0.0115      0.0000      0.0000      0.0159      0
.0191
      0.7881      0.9952     -0.0140      0.0115     -0.3148      0.9864     -0.0140      0.0112      0.0275      0.0268      0.0267      0
.0267
      0.7759      0.9906     -0.0007      0.0004     -0.9483      0.9728     -0.0007     -0.0003      0.0557      0.0545      0.0542      0
.0542
      0.0000      0.0000     -0.0270     -0.0270      0.9866      0.9728      0.0137      0.0345     -0.0281     -0.0277     -0.0275     -0
.0275
1
   network id:              index:   1    source type =  0    doublet type = 12    number rows =   8    number columns =   8

  jc    ip           x           y           z          d0          dx          dy          dz          s0         anx         any      a
nz
  lmachu           wxu         wyu         wzu        pheu         vxu         vyu         vzu      cplinu      cpslnu      cp2ndu    cpi
snu
  lmachl           wxl         wyl         wzl        phel         vxl         vyl         vzl      cplinl      cpslnl      cp2ndl    cpi
snl
     wnu           wnl        pwnu        pwnl         vtu         vtl        pvtu        pvtl      cplind      cpslnd      cp2ndd    cpi
snd

  36      21     35.6799      6.8943     -5.4639      0.5927      0.0260     -0.0197      0.0170      0.0000      0.0000      0.0159      0
.0191
      0.7952      0.9980     -0.0179      0.0144     -0.2957      0.9943     -0.0179      0.0143      0.0117      0.0109      0.0109      0
.0109
      0.7720      0.9890      0.0018     -0.0020     -0.8884      0.9683      0.0018     -0.0027      0.0648      0.0635      0.0631      0
.0631
      0.0000      0.0000     -0.0271     -0.0271      0.9945      0.9683      0.0051      0.0402     -0.0532     -0.0526     -0.0522     -0
.0522

  37      22     33.5845      6.8944     -5.4630      0.5225      0.0419     -0.0284      0.0247      0.0000      0.0000      0.0159      0
.0191
      0.8034      1.0011     -0.0229      0.0186     -0.2942      1.0033     -0.0229      0.0187     -0.0066     -0.0074     -0.0074     -0
.0074
      0.7661      0.9866      0.0055     -0.0051     -0.8167      0.9614      0.0055     -0.0060      0.0788      0.0772      0.0766      0
.0766
      0.0000      0.0000     -0.0271     -0.0271      1.0037      0.9614      0.0081      0.0487     -0.0854     -0.0846     -0.0840     -0
.0839

  38      23     31.4892      6.8943     -5.4624      0.4118      0.0690     -0.0454      0.0395      0.0000      0.0000      0.0159      0
.0191
      0.8171      1.0062     -0.0320      0.0267     -0.3148      1.0177     -0.0320      0.0271     -0.0360     -0.0371     -0.0373     -0
.0372
      0.7554      0.9822      0.0133     -0.0112     -0.7266      0.9487      0.0133     -0.0124      0.1046      0.1023      0.1013      0
.1012
      0.0000      0.0000     -0.0268     -0.0268      1.0186      0.9489      0.0268      0.0649     -0.1406     -0.1394     -0.1386     -0
.1384

  39      24     29.3942      6.8939     -5.4617      0.2250      0.1566     -0.1066      0.0926      0.0000      0.0000      0.0159      0
.0191
```

	0.8624	1.0217	-0.0639	0.0531	-0.3754	1.0626	-0.0639	0.0545	-0.1277	-0.1320	-0.1335	-0
.1332	0.7214	0.9673	0.0427	-0.0359	-0.6004	0.9059	0.0427	-0.0380	0.1919	0.1852	0.1819	0
.1810	0.0000	0.0000	-0.0270	-0.0270	1.0659	0.9077	0.0883	0.1227	-0.3195	-0.3172	-0.3154	-0
.3142												
42	25	44.1269	8.3988	-6.7254	0.6354	0.0002	-0.0095	0.0080	0.0000	0.0000	0.0142	0
.0169	0.7726	0.9890	-0.0100	0.0078	-0.4399	0.9689	-0.0100	0.0071	0.0628	0.0620	0.0616	0
.0616	0.7725	0.9891	-0.0005	-0.0002	-1.0752	0.9688	-0.0005	-0.0009	0.0637	0.0625	0.0621	0
.0621	0.0000	0.0000	-0.0272	-0.0272	0.9690	0.9688	0.0321	0.0380	-0.0009	-0.0005	-0.0005	-0
.0005												
43	26	42.2688	8.3986	-6.7242	0.6339	0.0024	-0.0117	0.0098	0.0000	0.0000	0.0141	0
.0169	0.7777	0.9910	-0.0125	0.0099	-0.3885	0.9747	-0.0125	0.0093	0.0512	0.0504	0.0502	0
.0501	0.7756	0.9904	-0.0008	0.0001	-1.0224	0.9723	-0.0008	-0.0005	0.0566	0.0554	0.0551	0
.0551	0.0000	0.0000	-0.0272	-0.0272	0.9748	0.9723	0.0256	0.0349	-0.0054	-0.0050	-0.0049	-0
.0049												
44	27	40.4108	8.3984	-6.7230	0.6254	0.0075	-0.0148	0.0126	0.0000	0.0000	0.0141	0
.0169	0.7831	0.9932	-0.0150	0.0120	-0.3482	0.9808	-0.0150	0.0116	0.0388	0.0381	0.0380	0
.0379	0.7764	0.9908	-0.0002	-0.0004	-0.9737	0.9733	-0.0002	-0.0010	0.0547	0.0535	0.0533	0
.0532	0.0000	0.0000	-0.0272	-0.0272	0.9810	0.9733	0.0189	0.0347	-0.0159	-0.0154	-0.0153	-0
.0153												
45	28	38.5529	8.3985	-6.7221	0.6045	0.0161	-0.0183	0.0156	0.0000	0.0000	0.0141	0
.0169	0.7892	0.9956	-0.0174	0.0140	-0.3198	0.9876	-0.0174	0.0137	0.0251	0.0244	0.0243	0
.0243	0.7748	0.9901	0.0009	-0.0013	-0.9243	0.9715	0.0009	-0.0019	0.0584	0.0571	0.0568	0
.0567	0.0000	0.0000	-0.0272	-0.0272	0.9878	0.9715	0.0118	0.0370	-0.0332	-0.0327	-0.0324	-0
.0324												
46	29	36.6947	8.3986	-6.7211	0.5641	0.0281	-0.0236	0.0203	0.0000	0.0000	0.0141	0
.0169	0.7962	0.9983	-0.0206	0.0167	-0.3050	0.9954	-0.0206	0.0166	0.0093	0.0086	0.0086	0
.0086	0.7711	0.9887	0.0029	-0.0030	-0.8690	0.9672	0.0029	-0.0037	0.0670	0.0656	0.0652	0
.0651	0.0000	0.0000	-0.0272	-0.0272	0.9957	0.9672	0.0057	0.0420	-0.0576	-0.0570	-0.0566	-0
.0565												
47	30	34.8366	8.3984	-6.7200	0.4978	0.0443	-0.0322	0.0279	0.0000	0.0000	0.0141	0
.0169	0.8049	1.0016	-0.0256	0.0208	-0.3059	1.0048	-0.0256	0.0209	-0.0098	-0.0106	-0.0106	-0
.0106	0.7653	0.9863	0.0066	-0.0061	-0.8037	0.9604	0.0066	-0.0070	0.0808	0.0791	0.0785	0

```
.0784
    0.0000     0.0000    -0.0272    -0.0272     1.0053     0.9605     0.0120     0.0503    -0.0905    -0.0897    -0.0891    -0
.0891
1
   network id:           index:   1    source type =  0    doublet type = 12    number rows =    8    number columns =    8

  jc   ip         x          y          z          d0         dx         dy         dz         s0         anx        any         a
nz
  lmachu         wxu        wyu        wzu        pheu       vxu        vyu        vzu        cplinu     cpslnu     cp2ndu      cpi
snu
  lmachl         wxl        wyl        wzl        phel       vxl        vyl        vzl        cplinl     cpslnl     cp2ndl      cpi
snl
    wnu          wnl        pwnu       pwnl       vtu        vtl        pvtu       pvtl       cplind     cpslnd     cp2ndd      cpi
snd

  48   31    32.9791     8.3980    -6.7188     0.3938     0.0734    -0.0501     0.0435     0.0000     0.0000     0.0141     0
.0169
    0.8197     1.0071    -0.0352     0.0291    -0.3278     1.0203    -0.0352     0.0295    -0.0415    -0.0428    -0.0429    -0
.0429
    0.7540     0.9816     0.0149    -0.0128    -0.7216     0.9469     0.0149    -0.0140     0.1082     0.1058     0.1047     0
.1046
    0.0000     0.0000    -0.0270    -0.0270     1.0214     0.9472     0.0315     0.0677    -0.1497    -0.1486    -0.1477    -0
.1475

  49   32    31.1216     8.3979    -6.7179     0.2164     0.1693    -0.1168     0.1013     0.0000     0.0000     0.0141     0
.0169
    0.8697     1.0241    -0.0695     0.0574    -0.3883     1.0693    -0.0695     0.0590    -0.1415    -0.1468    -0.1486    -0
.1481
    0.7171     0.9653     0.0473    -0.0400    -0.6047     0.9000     0.0473    -0.0423     0.2040     0.1963     0.1926     0
.1915
    0.0000     0.0000    -0.0272    -0.0272     1.0732     0.9023     0.0981     0.1312    -0.3455    -0.3431    -0.3411    -0
.3396

  52   33    44.1925     9.9036    -7.9837     0.5979     0.0014    -0.0196     0.0165     0.0000     0.0000     0.0123     0
.0148
    0.7754     0.9900    -0.0154     0.0123    -0.4289     0.9720    -0.0154     0.0116     0.0564     0.0557     0.0554     0
.0554
    0.7741     0.9899     0.0042    -0.0041    -1.0269     0.9705     0.0042    -0.0048     0.0604     0.0589     0.0586     0
.0585
    0.0000     0.0000    -0.0272    -0.0272     0.9722     0.9706     0.0276     0.0407    -0.0040    -0.0032    -0.0032    -0
.0032

  53   34    42.5718     9.9034    -7.9822     0.5938     0.0046    -0.0206     0.0173     0.0000     0.0000     0.0123     0
.0148
    0.7797     0.9918    -0.0174     0.0136    -0.3883     0.9769    -0.0174     0.0131     0.0465     0.0457     0.0455     0
.0455
    0.7756     0.9905     0.0032    -0.0036    -0.9821     0.9723     0.0032    -0.0043     0.0568     0.0553     0.0550     0
.0550
    0.0000     0.0000    -0.0275    -0.0275     0.9772     0.9724     0.0225     0.0386    -0.0103    -0.0096    -0.0095    -0
.0095

  54   35    40.9511     9.9029    -7.9807     0.5827     0.0091    -0.0221     0.0187     0.0000     0.0000     0.0123     0
.0148
    0.7842     0.9935    -0.0189     0.0154    -0.3562     0.9820    -0.0189     0.0150     0.0362     0.0355     0.0354     0
.0354
    0.7761     0.9907     0.0033    -0.0031    -0.9389     0.9729     0.0033    -0.0037     0.0557     0.0543     0.0540     0
.0540
```

```
     0.0000     0.0000    -0.0271    -0.0271     0.9822     0.9729     0.0175     0.0380    -0.0195    -0.0188    -0.0186    -0
.0186

  55     36    39.3304     9.9027    -7.9795     0.5632     0.0167    -0.0239     0.0204     0.0000     0.0000     0.0123     0
.0148
     0.7896     0.9957    -0.0208     0.0164    -0.3323     0.9879    -0.0208     0.0162     0.0242     0.0234     0.0234     0
.0234
     0.7747     0.9901     0.0031    -0.0035    -0.8956     0.9713     0.0031    -0.0042     0.0589     0.0575     0.0571     0
.0571
     0.0000     0.0000    -0.0275    -0.0275     0.9883     0.9713     0.0121     0.0393    -0.0347    -0.0340    -0.0338    -0
.0337

  56     37    37.7098     9.9028    -7.9781     0.5269     0.0293    -0.0281     0.0241     0.0000     0.0000     0.0123     0
.0148
     0.7969     0.9985    -0.0235     0.0187    -0.3200     0.9960    -0.0235     0.0186     0.0080     0.0071     0.0071     0
.0071
     0.7707     0.9885     0.0046    -0.0047    -0.8469     0.9667     0.0046    -0.0055     0.0682     0.0667     0.0662     0
.0662
     0.0000     0.0000    -0.0275    -0.0275     0.9964     0.9667     0.0083     0.0440    -0.0603    -0.0595    -0.0591    -0
.0591

  57     38    36.0892     9.9027    -7.9767     0.4661     0.0467    -0.0362     0.0313     0.0000     0.0000     0.0123     0
.0148
     0.8062     1.0021    -0.0281     0.0228    -0.3224     1.0060    -0.0281     0.0229    -0.0124    -0.0134    -0.0134    -0
.0134
     0.7644     0.9859     0.0082    -0.0075    -0.7885     0.9593     0.0082    -0.0084     0.0831     0.0812     0.0806     0
.0805
     0.0000     0.0000    -0.0273    -0.0273     1.0067     0.9594     0.0154     0.0525    -0.0955    -0.0946    -0.0940    -0
.0939

  58     39    34.4689     9.9023    -7.9753     0.3703     0.0782    -0.0549     0.0476     0.0000     0.0000     0.0123     0
.0148
     0.8222     1.0079    -0.0380     0.0311    -0.3443     1.0229    -0.0380     0.0316    -0.0467    -0.0482    -0.0484    -0
.0484
     0.7521     0.9808     0.0169    -0.0148    -0.7146     0.9447     0.0169    -0.0160     0.1128     0.1101     0.1090     0
.1088
     0.0000     0.0000    -0.0273    -0.0273     1.0241     0.9450     0.0359     0.0712    -0.1595    -0.1583    -0.1574    -0
.1571

  59     40    32.8484     9.9021    -7.9739     0.2042     0.1828    -0.1270     0.1100     0.0000     0.0000     0.0123     0
.0148
     0.8773     1.0265    -0.0749     0.0615    -0.4030     1.0762    -0.0749     0.0632    -0.1555    -0.1618    -0.1640    -0
.1634
     0.7122     0.9630     0.0522    -0.0444    -0.6072     0.8934     0.0522    -0.0468     0.2175     0.2087     0.2045     0
.2032
     0.0000     0.0000    -0.0275    -0.0275     1.0807     0.8962     0.1078     0.1406    -0.3731    -0.3705    -0.3684    -0
.3666
1
    network id:           index:   1   source type =  0   doublet type = 12    number rows =   8   number columns =   8

  jc   ip        x          y          z          d0         dx         dy         dz         s0        anx        any        a
nz
  lmachu        wxu        wyu        wzu        pheu       vxu        vyu        vzu       cp1inu     cps1nu     cp2ndu     cpi
snu
  lmachl        wxl        wyl        wzl        phel       vxl        vyl        vzl       cp1inl     cps1nl     cp2ndl     cpi
snl
    wnu         wnl        pwnu       pwnl       vtu        vtl        pvtu       pvtl      cp1ind     cps1nd     cp2ndd     cpi
```

```
snd

  62     41     44.2579    11.4079    -9.2422     0.5332     0.0019    -0.0316     0.0265     0.0000     0.0000     0.0105     0
.0126
     0.7779     0.9909    -0.0220     0.0173    -0.4324     0.9746    -0.0220     0.0168     0.0508     0.0500     0.0497     0
.0497
     0.7761     0.9908     0.0096    -0.0091    -0.9657     0.9728     0.0096    -0.0097     0.0564     0.0544     0.0541     0
.0540
     0.0000     0.0000    -0.0276    -0.0276     0.9750     0.9729     0.0253     0.0447    -0.0056    -0.0044    -0.0043    -0
.0043

  63     42     42.8745    11.4079    -9.2404     0.5290     0.0052    -0.0318     0.0267     0.0000     0.0000     0.0105     0
.0126
     0.7814     0.9923    -0.0235     0.0182    -0.4007     0.9786    -0.0235     0.0177     0.0428     0.0420     0.0418     0
.0418
     0.7767     0.9910     0.0083    -0.0084    -0.9297     0.9734     0.0083    -0.0090     0.0550     0.0530     0.0528     0
.0527
     0.0000     0.0000    -0.0279    -0.0279     0.9790     0.9735     0.0219     0.0432    -0.0122    -0.0111    -0.0110    -0
.0109

  64     43     41.4910    11.4075    -9.2387     0.5189     0.0087    -0.0320     0.0269     0.0000     0.0000     0.0105     0
.0126
     0.7848     0.9936    -0.0240     0.0196    -0.3750     0.9824    -0.0240     0.0192     0.0350     0.0342     0.0341     0
.0341
     0.7769     0.9911     0.0080    -0.0071    -0.8939     0.9738     0.0080    -0.0077     0.0542     0.0524     0.0521     0
.0521
     0.0000     0.0000    -0.0271    -0.0271     0.9829     0.9738     0.0189     0.0421    -0.0192    -0.0182    -0.0180    -0
.0180

  65     44     40.1079    11.4070    -9.2370     0.5042     0.0150    -0.0326     0.0276     0.0000     0.0000     0.0105     0
.0126
     0.7893     0.9954    -0.0255     0.0199    -0.3543     0.9874    -0.0255     0.0196     0.0250     0.0241     0.0241     0
.0241
     0.7757     0.9906     0.0071    -0.0073    -0.8584     0.9724     0.0071    -0.0080     0.0570     0.0552     0.0549     0
.0549
     0.0000     0.0000    -0.0279    -0.0279     0.9879     0.9724     0.0154     0.0426    -0.0320    -0.0311    -0.0308    -0
.0308

  66     45     38.7248    11.4071    -9.2351     0.4755     0.0279    -0.0352     0.0300     0.0000     0.0000     0.0105     0
.0126
     0.7965     0.9982    -0.0275     0.0215    -0.3428     0.9954    -0.0275     0.0214     0.0090     0.0080     0.0080     0
.0080
     0.7714     0.9888     0.0077    -0.0079    -0.8183     0.9674     0.0077    -0.0086     0.0669     0.0651     0.0647     0
.0646
     0.0000     0.0000    -0.0279    -0.0279     0.9960     0.9675     0.0131     0.0465    -0.0579    -0.0570    -0.0566    -0
.0566

  67     46     37.3418    11.4069    -9.2334     0.4248     0.0469    -0.0415     0.0357     0.0000     0.0000     0.0105     0
.0126
     0.8064     1.0020    -0.0309     0.0250    -0.3443     1.0061    -0.0309     0.0251    -0.0127    -0.0138    -0.0138    -0
.0138
     0.7644     0.9859     0.0106    -0.0096    -0.7691     0.9593     0.0106    -0.0106     0.0834     0.0814     0.0807     0
.0806
     0.0000     0.0000    -0.0274    -0.0274     1.0069     0.9594     0.0187     0.0548    -0.0962    -0.0952    -0.0945    -0
.0944

  68     47     35.9585    11.4065    -9.2317     0.3406     0.0821    -0.0598     0.0517     0.0000     0.0000     0.0105     0
```

```
.0126
   0.8242    1.0086   -0.0408    0.0328   -0.3642    1.0248   -0.0408    0.0334   -0.0507   -0.0524   -0.0526   -0
.0526
   0.7506    0.9801    0.0190   -0.0170   -0.7048    0.9427    0.0190   -0.0183    0.1170    0.1140    0.1127    0
.1125
   0.0000    0.0000   -0.0277   -0.0277    1.0262    0.9431    0.0396    0.0747   -0.1677   -0.1664   -0.1654   -0
.1651

 69     48  34.5750   11.4064   -9.2298    0.1888    0.1978   -0.1381    0.1195    0.0000    0.0000    0.0105    0
.0126
   0.8855    1.0291   -0.0806    0.0657   -0.4193    1.0836   -0.0806    0.0676   -0.1707   -0.1780   -0.1807   -0
.1799
   0.7067    0.9604    0.0575   -0.0493   -0.6081    0.8859    0.0575   -0.0519    0.2330    0.2228    0.2179    0
.2164
   0.0000    0.0000   -0.0279   -0.0279    1.0887    0.8892    0.1182    0.1511   -0.4036   -0.4009   -0.3986   -0
.3962

 72     49  44.3232   12.9125  -10.5007    0.4285    0.0014   -0.0546    0.0457    0.0000    0.0000    0.0087    0
.0104
   0.7803    0.9914   -0.0341    0.0272   -0.4570    0.9768   -0.0341    0.0267    0.0458    0.0446    0.0444    0
.0444
   0.7788    0.9919    0.0204   -0.0185   -0.8854    0.9753    0.0204   -0.0190    0.0519    0.0486    0.0484    0
.0483
   0.0000    0.0000   -0.0278   -0.0278    0.9777    0.9757    0.0308    0.0557   -0.0060   -0.0040   -0.0040   -0
.0039

 73     50  43.1771   12.9122  -10.4987    0.4256    0.0040   -0.0545    0.0457    0.0000    0.0000    0.0087    0
.0104
   0.7828    0.9924   -0.0352    0.0277   -0.4325    0.9795   -0.0352    0.0272    0.0403    0.0390    0.0389    0
.0388
   0.7789    0.9920    0.0193   -0.0179   -0.8581    0.9755    0.0193   -0.0184    0.0515    0.0484    0.0481    0
.0481
   0.0000    0.0000   -0.0281   -0.0281    0.9805    0.9759    0.0297    0.0545   -0.0112   -0.0093   -0.0093   -0
.0092
1
  network id:          index:   1   source type =  0   doublet type = 12    number rows =   8   number columns =   8

 jc   ip        x         y         z        d0        dx        dy        dz        s0       anx       any      a
nz
 lmachu       wxu       wyu       wzu      pheu       vxu       vyu       vzu    cplinu    cpslnu    cp2ndu    cpi
snu
 lmachl       wxl       wyl       wzl      phel       vxl       vyl       vzl    cplinl    cpslnl    cp2ndl    cpi
snl
    wnu       wnl      pwnu      pwnl       vtu       vtl      pvtu      pvtl    cplind    cpslnd    cp2ndd    cpi
snd

 74     51  42.0309   12.9120  -10.4967    0.4194    0.0065   -0.0537    0.0450    0.0000    0.0000    0.0087    0
.0104
   0.7852    0.9934   -0.0354    0.0282   -0.4115    0.9822   -0.0354    0.0278    0.0348    0.0335    0.0334    0
.0333
   0.7790    0.9920    0.0183   -0.0167   -0.8309    0.9757    0.0183   -0.0172    0.0509    0.0480    0.0477    0
.0477
   0.0000    0.0000   -0.0278   -0.0278    0.9833    0.9760    0.0284    0.0530   -0.0162   -0.0145   -0.0144   -0
.0144

 75     52  40.8853   12.9116  -10.4945    0.4102    0.0110   -0.0534    0.0448    0.0000    0.0000    0.0087    0
.0104
```

	0.7885	0.9947	-0.0361	0.0283	-0.3936	0.9859	-0.0361	0.0280	0.0275	0.0262	0.0261	0
.0261	0.7782	0.9917	0.0172	-0.0162	-0.8038	0.9748	0.0172	-0.0168	0.0527	0.0498	0.0495	0
.0495	0.0000	0.0000	-0.0282	-0.0282	0.9869	0.9751	0.0269	0.0524	-0.0252	-0.0236	-0.0234	-0
.0234												
76	53	39.7398	12.9114	-10.4924	0.3929	0.0211	-0.0536	0.0452	0.0000	0.0000	0.0087	0
.0104	0.7941	0.9969	-0.0368	0.0290	-0.3813	0.9921	-0.0368	0.0288	0.0150	0.0136	0.0135	0
.0135	0.7749	0.9903	0.0168	-0.0157	-0.7742	0.9711	0.0168	-0.0164	0.0602	0.0574	0.0571	0
.0570	0.0000	0.0000	-0.0281	-0.0281	0.9932	0.9713	0.0254	0.0538	-0.0452	-0.0438	-0.0435	-0
.0435												
77	54	38.5940	12.9110	-10.4904	0.3601	0.0390	-0.0560	0.0477	0.0000	0.0000	0.0087	0
.0104	0.8033	1.0005	-0.0382	0.0309	-0.3780	1.0022	-0.0382	0.0309	-0.0053	-0.0068	-0.0068	-0
.0068	0.7680	0.9875	0.0178	-0.0159	-0.7382	0.9632	0.0178	-0.0167	0.0760	0.0732	0.0726	0
.0725	0.0000	0.0000	-0.0276	-0.0276	1.0034	0.9635	0.0269	0.0591	-0.0813	-0.0800	-0.0794	-0
.0793												
78	55	37.4480	12.9106	-10.4883	0.2983	0.0783	-0.0700	0.0601	0.0000	0.0000	0.0087	0
.0104	0.8227	1.0078	-0.0463	0.0364	-0.3905	1.0228	-0.0463	0.0369	-0.0470	-0.0491	-0.0493	-0
.0493	0.7523	0.9809	0.0238	-0.0219	-0.6887	0.9445	0.0238	-0.0232	0.1138	0.1101	0.1089	0
.1087	0.0000	0.0000	-0.0285	-0.0285	1.0245	0.9451	0.0437	0.0780	-0.1608	-0.1592	-0.1583	-0
.1580												
79	56	36.3021	12.9107	-10.4861	0.1687	0.2123	-0.1512	0.1306	0.0000	0.0000	0.0087	0
.0104	0.8937	1.0315	-0.0871	0.0708	-0.4378	1.0907	-0.0871	0.0728	-0.1852	-0.1940	-0.1970	-0
.1961	0.7016	0.9578	0.0641	-0.0550	-0.6066	0.8784	0.0641	-0.0578	0.2483	0.2364	0.2309	0
.2289	0.0000	0.0000	-0.0282	-0.0282	1.0966	0.8826	0.1291	0.1625	-0.4335	-0.4304	-0.4279	-0
.4250												
82	57	44.3885	14.4174	-11.7593	0.2395	-0.0004	-0.1363	0.1141	0.0000	0.0000	0.0069	0
.0083	0.7852	0.9910	-0.0761	0.0613	-0.5250	0.9777	-0.0761	0.0609	0.0415	0.0350	0.0349	0
.0348	0.7847	0.9937	0.0602	-0.0526	-0.7644	0.9781	0.0602	-0.0532	0.0487	0.0375	0.0373	0
.0371	0.0000	0.0000	-0.0285	-0.0285	0.9826	0.9814	0.0781	0.1049	-0.0072	-0.0025	-0.0024	-0
.0024												
83	58	43.4799	14.4169	-11.7570	0.2381	0.0018	-0.1356	0.1135	0.0000	0.0000	0.0069	0
.0083	0.7872	0.9918	-0.0760	0.0618	-0.5067	0.9799	-0.0760	0.0614	0.0371	0.0306	0.0305	0
.0304	0.7846	0.9936	0.0596	-0.0515	-0.7448	0.9780	0.0596	-0.0521	0.0487	0.0378	0.0375	0

```
.0374
     0.0000   0.0000  -0.0281  -0.0281   0.9848   0.9812   0.0778   0.1037  -0.0116  -0.0072  -0.0071   -0
.0070
  84     59  42.5713  14.4167 -11.7548   0.2366   0.0029  -0.1345   0.1125   0.0000   0.0000   0.0069    0
.0083
     0.7886   0.9923  -0.0766   0.0612  -0.4894   0.9815  -0.0766   0.0608   0.0340   0.0275   0.0274    0
.0273
     0.7849   0.9938   0.0580  -0.0512  -0.7260   0.9785   0.0580  -0.0517   0.0477   0.0370   0.0368    0
.0366
     0.0000   0.0000  -0.0289  -0.0289   0.9863   0.9816   0.0775   0.1021  -0.0137  -0.0095  -0.0094   -0
.0093
  85     60  41.6630  14.4162 -11.7521   0.2332   0.0049  -0.1330   0.1112   0.0000   0.0000   0.0069    0
.0083
     0.7903   0.9931  -0.0762   0.0612  -0.4741   0.9834  -0.0762   0.0609   0.0301   0.0235   0.0235    0
.0234
     0.7848   0.9938   0.0568  -0.0498  -0.7072   0.9786   0.0568  -0.0503   0.0476   0.0372   0.0370    0
.0369
     0.0000   0.0000  -0.0286  -0.0286   0.9883   0.9815   0.0768   0.1004  -0.0175  -0.0137  -0.0136   -0
.0135
1
   network id:          index:   1   source type =  0   doublet type = 12   number rows =  8   number columns =  8
  jc    ip        x        y        z       d0       dx       dy       dz       s0      anx      any    a
nz
  lmachu         wxu      wyu      wzu     pheu      vxu      vyu      vzu   cplinu   cpslnu   cp2ndu  cpi
snu
  lmachl         wxl      wyl      wzl     phel      vxl      vyl      vzl   cplinl   cpslnl   cp2ndl  cpi
snl
     wnu         wnl     pwnu     pwnl      vtu      vtl     pvtu     pvtl   cplind   cpslnd   cp2ndd  cpi
snd
  86     61  40.7547  14.4158 -11.7497   0.2278   0.0077  -0.1302   0.1088   0.0000   0.0000   0.0069    0
.0083
     0.7923   0.9939  -0.0752   0.0605  -0.4606   0.9858  -0.0752   0.0603   0.0254   0.0191   0.0190    0
.0190
     0.7841   0.9936   0.0550  -0.0480  -0.6884   0.9780   0.0550  -0.0486   0.0485   0.0386   0.0384    0
.0383
     0.0000   0.0000  -0.0285  -0.0285   0.9905   0.9808   0.0752   0.0980  -0.0231  -0.0195  -0.0194   -0
.0193
  87     62  39.8463  14.4154 -11.7475   0.2185   0.0140  -0.1254   0.1050   0.0000   0.0000   0.0069    0
.0083
     0.7955   0.9954  -0.0731   0.0591  -0.4498   0.9898  -0.0731   0.0589   0.0176   0.0116   0.0116    0
.0116
     0.7817   0.9927   0.0523  -0.0454  -0.6683   0.9758   0.0523  -0.0460   0.0529   0.0437   0.0435    0
.0433
     0.0000   0.0000  -0.0282  -0.0282   0.9942   0.9783   0.0722   0.0950  -0.0353  -0.0321  -0.0318   -0
.0317
  88     63  38.9378  14.4150 -11.7451   0.1989   0.0410  -0.1251   0.1052   0.0000   0.0000   0.0069    0
.0083
     0.8084   1.0005  -0.0738   0.0587  -0.4450   1.0040  -0.0738   0.0589  -0.0109  -0.0170  -0.0170   -0
.0169
     0.7706   0.9881   0.0513  -0.0454  -0.6439   0.9631   0.0513  -0.0463   0.0783   0.0693   0.0687    0
.0685
```

```
     0.0000      0.0000    -0.0289    -0.0289     1.0085     0.9655     0.0722     0.0983    -0.0892    -0.0862    -0.0857    -0
.0854
    89    64    38.0294    14.4148   -11.7426     0.1326     0.1914    -0.1885     0.1613     0.0000     0.0000     0.0069     0
.0083
     0.8864      1.0273    -0.1057     0.0857    -0.4642     1.0800    -0.1057     0.0876    -0.1647    -0.1784    -0.1808    -0
.1798
     0.7126      0.9618     0.0828    -0.0712    -0.5968     0.8886     0.0828    -0.0738     0.2290     0.2112     0.2065     0
.2044
     0.0000      0.0000    -0.0286    -0.0286     1.0887     0.8955     0.1404     0.1732    -0.3937    -0.3896    -0.3873    -0
.3842
1
0*b*for-mom-net#-  1
                                        force / moment data for network     1



 totals for column     1        area        fx          fy          fz          mx          my          mz

                                40.29655    0.00000    -0.00355    -0.00424    -0.02639    -0.01477     0.0123
8
                                40.29655    0.00000     0.00999     0.01196     0.07635     0.05750    -0.0480
5
                                40.29655    0.00000     0.00644     0.00771     0.04996     0.04273    -0.0356
7

 totals for column     2        area        fx          fy          fz          mx          my          mz

                                36.57013    0.00000    -0.00156    -0.00186    -0.01623    -0.00475     0.0039
9
                                36.57013    0.00000     0.01074     0.01285     0.11449     0.05956    -0.0497
8
                                36.57013    0.00000     0.00918     0.01099     0.09826     0.05481    -0.0457
9

 totals for column     3        area        fx          fy          fz          mx          my          mz

                                32.84674    0.00000    -0.00043    -0.00051    -0.00566     0.00065    -0.0005
2
                                32.84674    0.00000     0.01025     0.01227     0.14047     0.05580    -0.0466
3
                                32.84674    0.00000     0.00982     0.01176     0.13480     0.05644    -0.0471
5

 totals for column     4        area        fx          fy          fz          mx          my          mz

                                29.12062    0.00000     0.00028     0.00034     0.00478     0.00379    -0.0031
```

5								
		29.12062	0.00001	0.00945	0.01131	0.15828	0.05062	-0.0422
8								
		29.12062	0.00001	0.00972	0.01165	0.16305	0.05440	-0.0454
2								
totals for column	5	area	fx	fy	fz	mx	my	mz
		25.40189	0.00000	0.00073	0.00088	0.01453	0.00560	-0.0046
5								
		25.40189	0.00001	0.00845	0.01012	0.16733	0.04459	-0.0372
3								
		25.40189	0.00001	0.00917	0.01100	0.18186	0.05018	-0.0418
8								
totals for column	6	area	fx	fy	fz	mx	my	mz
		21.67510	0.00000	0.00094	0.00114	0.02161	0.00619	-0.0051
4								
		21.67510	0.00001	0.00726	0.00870	0.16598	0.03775	-0.0315
2								
		21.67510	0.00001	0.00820	0.00984	0.18759	0.04394	-0.0366
6								
totals for column	7	area	fx	fy	fz	mx	my	mz
		17.95490	0.00000	0.00085	0.00103	0.02206	0.00525	-0.0043
6								
		17.95490	0.00001	0.00580	0.00695	0.14997	0.02966	-0.0247
6								
		17.95490	0.00001	0.00665	0.00797	0.17204	0.03491	-0.0291
2								
totals for column	8	area	fx	fy	fz	mx	my	mz
		14.22880	0.00000	0.00037	0.00045	0.01058	0.00233	-0.0019
4								
		14.22880	0.00001	0.00352	0.00422	0.10168	0.01772	-0.0147
9								
		14.22880	0.00001	0.00389	0.00467	0.11226	0.02005	-0.0167
3								
totals for network		area	fx	fy	fz	mx	my	mz
		218.09473	0.00000	-0.00237	-0.00279	0.02527	0.00427	-0.0033
9								
		218.09473	0.00005	0.06546	0.07837	1.07455	0.35320	-0.2950

```
3
                                   218.09473      0.00006      0.06308      0.07559      1.09982      0.35747      -0.2984
2

 totals for all networks so far    area           fx           fy           fz           mx           my           mz

                                   218.09473      0.00000     -0.00237     -0.00279      0.02527      0.00427      -0.0033
9
                                   218.09473      0.00005      0.06546      0.07837      1.07455      0.35320      -0.2950
3
                                   218.09473      0.00006      0.06308      0.07559      1.09982      0.35747      -0.2984
2
0*e*for-mom
1
   network id:          index:   2   source type =  0   doublet type = 12   number rows =  8   number columns =  8
  jc   ip        x        y        z        d0       dx       dy       dz       s0       anx      any      a
nz
  lmachu        wxu      wyu      wzu      pheu     vxu      vyu      vzu      cplinu   cpslnu   cp2ndu   cpi
snu
  lmachl        wxl      wyl      wzl      phel     vxl      vyl      vzl      cplinl   cpslnl   cp2ndl   cpi
snl
     wnu        wnl      pwnu     pwnl     vtu      vtl      pvtu     pvtl     cplind   cpslnd   cp2ndd   cpi
snd

  112     65   43.9301  -2.9497  -3.8857  -0.3830   0.0239   0.1109   0.1332   0.0000   0.0000   0.0234   -0
.0196
      0.7810    0.9895   0.0571   0.0684  -1.0960   0.9741   0.0571   0.0679   0.0483   0.0439   0.0437    0
.0436
      0.7609    0.9839  -0.0538  -0.0641  -0.7130   0.9501  -0.0538  -0.0653   0.1054   0.0928   0.0918    0
.0914
      0.0000    0.0000   0.0222   0.0222   0.9781   0.9539   0.0669   0.1218  -0.0571  -0.0489  -0.0481   -0
.0477

  113     66   41.3597  -2.9495  -3.8858  -0.4581   0.0263   0.0643   0.0775   0.0000   0.0000   0.0234   -0
.0196
      0.7883    0.9942   0.0345   0.0412  -1.0532   0.9853   0.0345   0.0409   0.0278   0.0266   0.0265    0
.0265
      0.7655    0.9864  -0.0298  -0.0356  -0.5950   0.9590  -0.0298  -0.0366   0.0857   0.0800   0.0793    0
.0791
      0.0000    0.0000   0.0224   0.0224   0.9867   0.9601   0.0302   0.0842  -0.0579  -0.0534  -0.0528   -0
.0526

  114     67   38.7894  -2.9495  -3.8858  -0.5064   0.0122   0.0308   0.0371   0.0000   0.0000   0.0234   -0
.0196
      0.7849    0.9936   0.0181   0.0216  -1.0143   0.9826   0.0181   0.0212   0.0345   0.0340   0.0339    0
.0339
      0.7743    0.9901  -0.0127  -0.0152  -0.5079   0.9705  -0.0127  -0.0159   0.0614   0.0587   0.0584    0
.0583
      0.0000    0.0000   0.0224   0.0224   0.9830   0.9707   0.0168   0.0553  -0.0269  -0.0248  -0.0245   -0
.0245

  115     68   36.2197  -2.9493  -3.8859  -0.5195  -0.0020   0.0076   0.0091   0.0000   0.0000   0.0234   -0
.0196
      0.7800    0.9921   0.0066   0.0081  -0.9653   0.9774   0.0066   0.0076   0.0459   0.0451   0.0449    0
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